

# DEPARTMENT OF BIOLOGY, HEALTH, AND THE ENVIRONMENT

## Mission Statement

The mission of the Department of Biology, Health, and the Environment is to educate, inspire, and assist students and diverse regional populations through a comprehensive curriculum, emergent pedagogy, and collaborative research. We focus on the complexity and factors that influence life, and we strive to understand how the processes that sustain life and enable biological innovation operate and interact within and across different scales of organization: from molecules to cells, tissues to organisms, species, ecosystems, biomes, and the Earth.

## General Information

To create a well-rounded graduate, students are encouraged to get involved in research and outreach activities as soon as possible. Faculty conduct research related to how environments affect cells, microbes, plants, animals, and ecosystems. Researchers' interests range from cell growth, development, and reproduction, to the effects of hormones on plant growth and development, to signaling between plants and ecology. The department also has a strong core of faculty interested in conserving and restoring our natural resources, including soil health, river restoration, and wildlife habitat.

## Program Outcomes

The Department of Biology, Health, and the Environment programs provide students the opportunity to:

- Explain foundational concepts related to the specific degree.
- Apply the process of scientific inquiry.
- Demonstrate critical thinking skills.
- Use appropriate field and/or laboratory methods to collect quality data.
- Use appropriate quantitative and qualitative methods to evaluate scientific data.
- Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
- Effectively communicate scientific information and the relationship between science and society to a diverse audience through oral, written, and visual means.

## Degrees

The Department of Biology, Health, and the Environment (IB) offers Bachelor of Science (B.S.) Degrees in Biology, Environmental Science, and Multidisciplinary Science for Teaching. The Department also offers a Bachelor of Arts (B.A.) in Environmental Studies and minors in Biology and Environmental Science.

The B.S. Degree in Biology is designed to prepare students for professional careers in the biological sciences, medical and health service fields, research, industry, and education. The program of study is structured around a comprehensive curriculum that includes genetics, physiology, cell biology, chemistry, physics, computer science, and mathematics. This foundational knowledge, along with laboratory experience, prepares students for research and technical positions in

universities, government, and industry. For students planning to attend medical, dental, or graduate school in biological and applied sciences, this major provides a strong foundation in the basic life sciences. At the upper-division level, students wanting to specialize can choose from five concentrations: Premedical Sciences, Ecology, Plant Biology, Grades 7–12 Biology Teacher Certification, and Developmental & Regenerative Biology (administered by the Department of Neuroscience, Developmental & Regenerative Biology (<http://catalog.utsa.edu/undergraduate/sciences/neuroscience/>)). Some of the careers a B.S. Degree in Biology will prepare students for are: animal scientist, biochemist, bio-engineer, biometrician, botanist, chiropractor, dentist, ecologist, food scientist technologist, forester, medical librarian, medical technologist, microbiologist, molecular biologist, neurobiologist, ophthalmologist, optometrist, pharmaceutical salesperson, pharmacy technician, physical therapist, physician, physician assistant, radiation technologist, research scientist, science teacher, park naturalist, test and inspection technician, veterinarian, wildlife biologist, zoologist, or a zoo or aquarium administrator.

The B.S. Degree in Environmental Science is designed for students interested in studying environmental problems from a scientific perspective. The major prepares students to deal with issues arising from the impact of human interaction on natural systems. The program of study is structured around a comprehensive curriculum that includes botany, zoology, geology, environmental statistics, geographical information systems, environmental law, soils, watershed processes, global change, fate and transport of chemicals, and environmental assessment. Students may choose to specialize further in one of four focus areas: 1) conservation and restoration ecology, 2) environmental management, 3) natural resources and wildlife management, and 4) aquatic sciences. Students will gain hands-on experience with many of the instrumental techniques used in environmental analysis and have the opportunity to engage in teamwork for field studies, excursions, and laboratory studies. There is a strong emphasis on producing graduates with well-developed oral and written communication skills who are capable of complex problem-solving. Some of the careers a B.S. degree in Environmental Science will prepare students for are: environmental biologist, environmental chemist, environmental consultant, environmental engineer, environmental geologist, environmental health and safety officer, environmental health officer, environmental lawyer, environmental manager, environmental science teacher, environmental scientist, environmental specialist, environmental technician, geographer, microbiologist, water quality scientist, or wildlife biologist.

The B.A. Degree in Environmental Studies is designed to provide students with a multidisciplinary educational approach regarding environmental issues and foster system-thinking skills. The degree reinforces the crucial role of interdisciplinary approaches in environmental problem solving by emphasizing the sociocultural, historical, ethical, spiritual, economic, and political dimensions of complex environmental issues. Solving these problems requires an integration of disciplines to provide the understanding needed to address complex environmental issues. The field includes study in basic principles of ecology and environmental science, as well as associated subjects such as ethics, geography, policy, politics, law, economics, philosophy, environmental sociology, environmental justice, urban planning, pollution control, and natural resource management. Some of the careers a B.A. degree in Environmental Studies will prepare students for are environmental consultant, environmental educator, environmental lobbyist, environmental planner, environmental attorney, natural resource specialist, outdoor education teacher, park naturalist, park

ranger, resource economist, policy analyst, public relations specialist, sustainability specialist, and urban and regional planner. The field includes study in basic principles of ecology and environmental science, as well as associated subjects such as ethics, geography, policy, politics, law, economics, philosophy, environmental sociology, environmental justice, urban planning, pollution control, and natural resource management.

The B.S. Degree in Multidisciplinary Science for Teaching is designed for future secondary science teachers and gives students broad training across the sciences. The B.S. Degree prepares students for the 7-12 (Composite) Science teacher certification. Some of the careers a B.S. degree in Multidisciplinary Science for Teaching will prepare students for are: teaching various science courses in grades 7-12, including biology, chemistry, physics, integrated physics and chemistry, astronomy, Earth and space science, environmental systems, aquatic science, anatomy and physiology, medical microbiology, pathophysiology, and scientific research and design.

## Health Careers Pathways

The Department of Biology, Health, and the Environment offers programs that support students interested in pursuing professional or graduate programs (e.g., medical, dental) in health-related professions through the B.S. Biology degree. Biology majors can also participate in the Joint Early Acceptance Program between UTSA and UT Health San Antonio, where students can earn their B.S. Biology degree from UTSA with a Master of Science (M.S.) in Respiratory Care, Master of Science (M.S.) in Medical Laboratory Sciences, or Doctor of Physical Therapy from UT Health San Antonio. See the Degrees (p. 2) page and visit the UTSA Health Professions office (<https://www.utsa.edu/healthprofessions/>) for more information.

## UTeachSA Teacher Preparation Program

UTeachSA (<https://www.utsa.edu/uteachsa/>) is the teacher preparation program in the College of Sciences that prepares students to become secondary (middle school and high school) science and mathematics teachers. The Department of Biology, Health, and the Environment offers two programs leading to teacher certification for the state of Texas: B.S. in Biology with a Concentration in Grades 7-12 Biology Teaching Certification and B.S. in Multidisciplinary Science for Teaching (Grades 7-12 Science).

## Criminal History Policy and Acknowledgement for Teacher Preparation Programs

Teacher preparation programs at UTSA require fieldwork in public schools, which requires students to be able to pass a criminal background check. It is the responsibility of the student to determine if their criminal history background will present a problem before applying for admission to the teacher preparation program. Students with a problematic criminal history will encounter difficulty in completing any fieldwork requirements and may not be able to complete the program. The University of Texas at San Antonio is required to inform students of the requirements set forth by the Texas Occupation Code, Chapter 53, Sections 53.001 through 53.105 (<https://statutes.capitol.texas.gov/Docs/OC/htm/OC.53.htm>).

## COS Signature Experiences in Biology, Health, and the Environment

The Department of Biology, Health, and the Environment offers experiential learning opportunities for undergraduate students in

which they can gain real-world experiences, while also learning about the broader impacts of their work within their fields of study. All undergraduate students have the option to participate in a College of Sciences (COS) Signature Experience. Students should contact the Undergraduate Advisor(s) of Record for the Biology, Environmental Science, Environmental Studies, or Multidisciplinary Science for Teaching majors for a list of relevant signature experiences.

## Sophomore Biology Research Initiative

The Sophomore Biology Research Initiative allows eligible students to engage in authentic research with faculty and graduate students while earning academic credit. The opportunity to be part of the SBRI is limited, so students should register early. Students who elect to participate in the Sophomore Biology Research Initiative will take BIO 2073 followed by BIO 3053 during their sophomore year, after completing their first 30 hours. A total of six hours will be completed. During their junior year, students are encouraged to take BIO 3382 and to serve as a mentor to sophomore students.

Students working in teams will conduct their research projects on a specific biological problem over two semesters. Several different research topics will be available to choose from. There will be approximately two hours of lecture/lab meetings and six hours of lab work per week. Students will present their final data in poster format at an organized symposium.

- B.S. Degree in Biology (p. 2)
  - Concentration in Ecology (p. 4)
  - Concentration in Plant Biology (p. 5)
  - Concentration in Premedical Sciences (p. 4)
  - Concentration in 7-12 Biology Teacher Certification (p. 5)
  - Concentration in Developmental and Regenerative Sciences (p. 5)
- B.S. Degree in Environmental Science (p. 10)
- B.A. Degree in Environmental Studies (p. 13)
- B.S. Degree in Multidisciplinary Science for Teaching (p. 15)

## Bachelor of Science Degree in Biology

The B.S. in Biology has five concentrations: Premedical Sciences, Ecology, Plant Biology, Developmental and Regenerative Sciences, and Grades 7-12 Biology Teacher Certification. The B.S. in Biology includes 42 credit hours of the university core curriculum, 11 credit hours of lower-division requirements, 9 credit hours of upper-division requirements, 3-6 hours of advanced laboratory options, and 21 hours of biology electives. Support work includes 13 credit hours of chemistry, 6 credit hours of mathematics and statistics, 8 credit hours of physics, 3 credit hours of computer science, and 6 credit hours of communication courses. Additional requirements and recommendations for the various concentration are described in each of the concentration descriptions below.

A minimum number of 120 semester credit hours is required for the B.S. in Biology, except for the concentration in Grades 7-12 Biology Teaching Certification, which requires 124 credit hours, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and required prerequisites must be completed with a grade of "C-" or better. Each concentration program

in the B.S. Degree in Biology program may have additional cumulative minimum grade point average requirements for its coursework.

## Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. Degree in Biology must complete University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both degree requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

MAT 1073, MAT 1093, and MAT 1193 may be used to satisfy the Core Curriculum requirement in the Mathematics Component Area and a major requirement.

BIO 1203, BIO 1223, PHY 1943, or PHY 1963 may be used for the six hours of Core Curriculum requirement in the Life and Physical Sciences Component Area, as well as major requirements.

ENG 2413 is a major requirement and satisfies the Core Curriculum requirement in the Core Component Option.

PSY 1013 is required for the Concentration in Premedical Sciences and satisfies the Core Curriculum requirement in the Social and Behavioral Component Area.

### Core Curriculum Component Area Requirements (<http://catalog.utsa.edu/undergraduate/bachelorsdegree/requirements/degree/requirements/corecurriculumcomponentarearequirements/>)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
<b>Total Credit Hours</b>	<b>42</b>

## Degree Requirements

Code	Title	Credit Hours
<b>A. Required courses in the major</b>		
1. Biology lower-division requirements:		11
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors	
BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors	
BIO 2313	Genetics	
2. Biology upper-division requirements:		9
Select three (3) out of the following options:		
BIO 3283	Ecology	
BIO 3323	Evolution	

BIO 3413	General Physiology	
BCH 3303	Essentials of Biochemistry	
MMI 3713	Microbiology	
NDRB 3813	Cell Biology	
NDRB 3913	Molecular Biology	
3. Advanced laboratory options:		3-6
Select two (2) laboratory courses from the following:		
BCH 3312	Biochemistry Laboratory for the Life Sciences	
BIO 2073	Sophomore Research Experience (CURE) I	
BIO 2362	Molecular Genetics Laboratory	
BIO 3053	Sophomore Research Experience (CURE) II	
BIO 3292	Ecology Laboratory	
BIO 3422	Physiology Laboratory	
BIO 3642	Clinical Anatomy Laboratory I	
BIO 3652	Clinical Anatomy Laboratory II	
BIO 4241	Field Biology Laboratory	
MMI 3722	Microbiology Laboratory	
MMI 4752	Immunology Laboratory	
NDRB 3442	Neurobiology Laboratory	
NDRB 4132	Developmental Biology Laboratory	
4. Biology electives:		21
a. Students may take any upper-division course in BIO, MMI, or NDRB.		
b. For students interested in focusing on computational biology, we recommend BIO 3523 Advanced Computational Biology and BIO 3253 R Coding in Environmental Science and Ecology.		
c. Students pursuing the Concentration in Grades 7-12 Teacher Certification can replace two upper-division Biology electives (6 credits) with two upper-division UTE courses.		
<b>B. Support work</b>		
The support courses listed below are mandatory prerequisites for various biology courses starting in a student's sophomore year. Students need to complete their support work as soon as possible, in their freshman and sophomore years, to be eligible to register for upper-division biology core courses and electives. Failure to complete the support courses listed below in a timely fashion will significantly delay a student's progress toward graduation.		
1. Required chemistry courses:		13
CHE 1103 & CHE 1121	General Chemistry I and General Chemistry I Laboratory	
CHE 1113 & CHE 1131	General Chemistry II and General Chemistry II Laboratory	
CHE 2603 & CHE 2612	Organic Chemistry I and Organic Chemistry I Laboratory	
2. Required mathematics and statistics courses:		6
MAT 1073	Algebra for Scientists and Engineers	
or MAT 1093	Precalculus	
or MAT 1193	Calculus for the Biosciences	
STA 1403	Probability and Statistics for the Biosciences	
Students pursuing the Concentration in Grades 7–12 Teacher Certification can substitute STA 1053 for both MAT 1073/MAT 1093/MAT 1193 and STA 1403.		
3. Required physics courses selected from one of the following options:		8

### Option 1

PHY 1603 & PHY 1611	Algebra-based Physics I and Algebra-based Physics I Laboratory *
PHY 1623 & PHY 1631	Algebra-based Physics II and Algebra-based Physics II Laboratory *

### Option 2

PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory *
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory *

\*Note: Students in the Concentration in Grades 7-12 Teaching Certification have a defined program of study outlined below. Physics laboratories noted by an asterisk are not required for the Concentration in Grades 7-12 Teaching Certification.

### 4. Required computer science course: 3

BIO 1173 or CS 1173	Introduction to Computational Biology Data Analysis and Visualization
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### 5. Required communication courses 6

ENG 2413	Technical Writing (also satisfies core requirement)
COM 2113	Public Speaking

### C. Free electives 7-10

a. Select 7-10 semester credit hours of free electives, depending on the laboratory sequence chosen under section 3, to complete 120 hours. 5-7 credit hours must be at the upper-division level to reach the minimum requirement of 39 upper-division semester credit hours.

b. Students pursuing the Concentration in Grades 7–12 Teacher Certification will take required courses for teacher certification in lieu of free electives (see concentration requirements below).

c. Students interested in focusing on computational biology should take ES 2113 Geographical Information Systems

### Total Credit Hours 87-93

## Concentrations

For students interested in research, teaching, graduate, or professional programs, the Department of Integrative Biology offers five concentrations. To declare a concentration or obtain advice, students should consult an undergraduate advisor in Life and Health Sciences Advising. If a student takes any of the courses listed below that satisfy the Biology degree and concentration, the student may need to take additional upper-division Biology courses to meet the minimum number of semester credit hours required for the Biology degree. Students who do not satisfy all requirements of a given concentration will receive a general B.S. degree in Biology.

### Concentration in Premedical Sciences

The B.S. degree in Biology with a Concentration in Premedical Sciences is designed to prepare students for professional programs in medicine, dentistry, pharmacy, or veterinary science. This concentration has a recommended curriculum that is designed to meet the requirements for entry into these professional schools and to prepare students for the MCAT, DAT, PCAT, or GRE examinations. The coursework within the Concentration in Premedical Sciences must be completed with a minimum cumulative grade point average of 3.0 or better. All candidates for the Concentration in Premedical Sciences must complete the following:

Code	Title	Credit Hours
BIO 1001	Introduction to Careers in the Health Professions	1
BIO 2992	Medical Terminology	2
BIO 3002	Professional Development for Pre-Medical Sciences	2
BIO 3413 & BIO 3422	General Physiology and Physiology Laboratory	5
BIO 3643 & BIO 3642	Advanced Physiology I and Clinical Anatomy Laboratory I	5
BIO 3653 & BIO 3652	Advanced Physiology II and Clinical Anatomy Laboratory II	5
BCH 3303	Essentials of Biochemistry	3
CHE 3643	Organic Chemistry II	3
PSY 1013	Introduction to Psychology (meets Core Curriculum requirement for Social and Behavior Component Area)	3
MMI 3013	Introduction to Clinical Medicine and Pathology	3
MMI 4473	Advanced Clinical Medicine and Pathology	3
NDRB 3433	Neurobiology	3
<b>Total Credit Hours</b>		<b>38</b>

### Concentration in Ecology

The coursework within the Concentration in Ecology must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in BIO 4923 Laboratory Research: Biology Concentrations as part of their program of study.

All candidates for the Concentration in Ecology must complete the following:

Code	Title	Credit Hours
BIO 3283	Ecology	3
BIO 3292	Ecology Laboratory	2
Select three of the following:		9
BIO 3073	Environmental Rhetoric and Technical Communication	
BIO 3113	Ichthyology	
BIO 3213	Animal Behavior	
BIO 3233	Survey of Insects	
BIO 3253	R Coding in Environmental Science and Ecology	
BIO 3293	Mammalogy	
BIO 3303	Entomology	
BIO 3323	Evolution	
BIO 3353	Herpetology	
BIO 4033	Conservation Biology	
BIO 4053	Wildlife Ecology	
BIO 4063	Ornithology	
BIO 4233	Field Biology	
BIO 4263	River Ecosystems	
BIO 4273	Fish Ecology	
BIO 4283	Plant-Soil-Microbe Interactions	



BIO 4303	Aquatic Ecology
BIO 4323	Restoration Ecology
BIO 4923	Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in ecological research.)
MMI 4773	Microbial Ecology and Metagenomics

**Total Credit Hours** **14**

### Concentration in Plant Biology

The coursework within the Concentration in Plant Biology must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in BIO 4923 Laboratory Research: Biology Concentrations as part of their program of study.

All candidates for the Concentration in Plant Biology must complete the following:

Code	Title	Credit Hours
BIO 3343	Plant Cell Biology	3
BIO 4313	Plant Physiological Ecology	3
Select three of the following:		9
BIO 3263	Woody Plant Identification	
BIO 3273	Wildflower Identification	
BIO 3333	Plants and Society	
BIO 4283	Plant-Soil-Microbe Interactions	
BIO 4643	Medicinal Plants	
BIO 4923	Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in plant-based research.)	

**Total Credit Hours** **15**

### Concentration in Grades 7–12 Biology Teacher Certification

The B.S. degree in Biology with a Concentration in Grades 7-12 Biology Teacher Certification is designed to prepare students for professional careers in teaching Biology at the secondary education level. The program of study is structured around a comprehensive Biology curriculum and state requirements for grades 7–12 life science teaching certification. Students cannot receive a B.S. degree with Teacher Certification without completing the teacher certification coursework. A student who does not complete the Biology teacher certification must transfer to the B.S. degree in Biology, B.S. in Developmental & Regenerative Sciences, or B.S. degree in Microbiology and Immunology to receive a degree in Biology.

The minimum number of semester credit hours required for the B.S. degree in Biology with Teacher Certification, including the Core Curriculum requirements, is 124. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level. The coursework within the Concentration in Grades 7–12 Biology Teacher Certification must be completed with a minimum cumulative grade point average of 2.5 or better.

All candidates for the Concentration in Grades 7–12 Biology Teacher Certification must complete the following:

Code	Title	Credit Hours
BIO 3283	Ecology	3
BIO 3323	Evolution	3
MMI 3713	Microbiology	3
NDRB 3613	Brain and Behavior	3
ESL 3083	Second Language Teaching and Learning for Grades 7-12	3
LTED 3773	Reading and Writing Across the Disciplines- Grades 7–12	3
SPE 3603	Introduction to Special Education	3
UTE 1111	Introduction to STEM Teaching Step 1	1
UTE 1122	Introduction to STEM Teaching Step 2	2
UTE 3023	Perspectives on Science and Mathematics	3
UTE 3203	Knowing and Learning in Mathematics and Science	3
UTE 3213	Classroom Interactions	3
UTE 4203	Project-Based Instruction	3
UTE 4646	Clinical Teaching	6

**Total Credit Hours** **42**

### Concentration in Developmental and Regenerative Sciences

The B.S. in Biology with a Concentration in Developmental and Regenerative Sciences (DRS) is designed to provide students with a comprehensive understanding of the fundamental principles and mechanisms underlying the growth and development of organisms, as well as the processes involved in tissue regeneration and repair. The DRS concentration is housed within the Department of Neuroscience, Developmental and Regenerative Biology (<http://catalog.utsa.edu/undergraduate/sciences/neuroscience/>). The coursework within the DRS Concentration must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in NDRB 4923 as part of their program of study. Students should plan on taking courses for this concentration in their third and fourth years.

All candidates for the Concentration in Developmental and Regenerative Sciences must complete the following:

Code	Title	Credit Hours
NDRB 3913	Molecular Biology	3
NDRB 4132	Developmental Biology Laboratory	2
NDRB 4143	Developmental Biology	3
Select two of the following:		6
NDRB 3663	Human Embryology	
NDRB 3813	Cell Biology	
NDRB 3993	Principles of Cancer Biology	
NDRB 4153	Frontiers in Human Pluripotent Stem Cells	
NDRB 4163	Epigenetics	
NDRB 4173	Genomics and Bioinformatics	
NDRB 4483	Developmental Neuroscience	
NDRB 4913	Independent Study (must be DRS-related topic)	
NDRB 4923	Laboratory Research (must be performed in a laboratory engaged in DRS-based research)	

NDRB 4953	Special Studies (must be DRS-related topic)	
NDRB 4993	Directed Research (must be DRS-related research)	
<b>Total Credit Hours</b>		<b>14</b>

## Course Sequence Guide for B.S. Degrees in Biology

### B.S. in Biology – Recommended Four-Year Academic Plan for the General B.S. in Biology or Concentrations in Developmental and Regenerative Sciences, Ecology, or Plant Biology

See below for the recommended four-year plan for students accepted to the Sophomore Biology Research Initiative, Concentration in Premedical Sciences, or Concentration in Grades 7-12 Biology Teaching Certification.

This course sequence guide is designed to assist students in completing their general B.S. degree in Biology or with concentrations in Developmental and Regenerative Sciences, Ecology, or Plant Biology. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may take courses during Summer terms to reduce course loads during long semesters.**

#### First Year

Fall		Credit Hours
AIS 1263	AIS: Life and Health Sciences	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)	4
CHE 1103 & CHE 1121	General Chemistry I and General Chemistry I Laboratory	4
WRC 1013	Freshman Composition I (core)	3
<b>Credit Hours</b>		<b>14</b>

#### Spring

BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major)	4
CHE 1113 & CHE 1131	General Chemistry II and General Chemistry II Laboratory	4
MAT 1073 or MAT 1093 or MAT 1193	Algebra for Scientists and Engineers or Precalculus or Calculus for the Biosciences	3
WRC 1023	Freshman Composition II (core)	3
<b>Credit Hours</b>		<b>14</b>

#### Second Year

Fall		Credit Hours
BIO 2313	Genetics	3
CHE 2603 & CHE 2612	Organic Chemistry I and Organic Chemistry I Laboratory	5
STA 1403	Probability and Statistics for the Biosciences	3
ENG 2413	Technical Writing (core)	3
<b>Credit Hours</b>		<b>14</b>

#### Spring

BIO 1173	Introduction to Computational Biology	3
Biology Upper-Division Requirements (see section A.2)		3
Advanced Laboratory Options (see section A.3). For Concentration in Ecology, take BIO 3292.		2
Select one of the following:		4
PHY 1603 & PHY 1611	Algebra-based Physics I and Algebra-based Physics I Laboratory	
or		
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	
Social and Behavioral (core)		3
<b>Credit Hours</b>		<b>15</b>

#### Third Year

Fall		Credit Hours
Biology Upper-Division Requirements (see section A.2)		3
COM 2113	Public Speaking	3
Select one of the following:		4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	
or		
PHY 1623 & PHY 1631	Algebra-based Physics II and Algebra-based Physics II Laboratory	
American History (core)		3
Language, Philosophy & Culture (core)		3
<b>Credit Hours</b>		<b>16</b>

#### Spring

Biology Upper-Division Requirements (see section A.2)	3
Upper-Division Biology Electives (see section A.4)	3
Government-Political Science (core)	3
Creative Arts (core)	3
Upper-Division Biology Electives (see section A.4)	3
For Concentration in Plant Biology take BIO 3343 Plant Cell Biology	
<b>Credit Hours</b>	<b>15</b>

#### Fourth Year

Fall		Credit Hours
Upper-Division Biology Electives (see section A.4)		3
Upper-Division Biology Electives (see section A.4)		3
Advanced Laboratory Options (see section A.3)		2
Free Upper-Division Elective (see section C)		3
Free Upper-Division Elective (see section C)		3
American History (core)		3
<b>Credit Hours</b>		<b>17</b>

#### Spring

Upper-Division Biology Electives (see section A.4)	3
Upper-Division Biology Electives (see section A.4)	3

Upper-Division Biology Electives (see section A.4)	3
Free Upper-Division Elective (see section C)	3
Government-Political Science (core)	3
<b>Credit Hours</b>	<b>15</b>
<b>Total Credit Hours</b>	<b>120</b>

Note: Some courses are only offered once a year, in Fall or Spring. Check with the Department of Integrative Biology for the scheduling of courses.

### B.S. in Biology – Recommended Four-Year Academic Plan for Students Participating in *Sophomore Biology Research Initiative*

This course sequence guide is designed to assist students in completing their B.S. Degree in Biology for students participating in the Sophomore Biology Research Initiative. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

#### First Year

Fall		Credit Hours
AIS 1263	AIS: Life and Health Sciences	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)	4
CHE 1103 & CHE 1121	General Chemistry I and General Chemistry I Laboratory	4
WRC 1013	Freshman Composition I (core)	3
<b>Credit Hours</b>		<b>14</b>

#### Spring

BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major)	4
CHE 1113 & CHE 1131	General Chemistry II and General Chemistry II Laboratory	4
MAT 1073 or MAT 1093 or MAT 1193	Algebra for Scientists and Engineers or Precalculus or Calculus for the Biosciences	3
WRC 1023	Freshman Composition II (core)	3
<b>Credit Hours</b>		<b>14</b>

#### Second Year

Fall		Credit Hours
BIO 2313	Genetics	3
BIO 2073	Sophomore Research Experience (CURE) I	3
CHE 2603 & CHE 2612	Organic Chemistry I and Organic Chemistry I Laboratory	5
STA 1403	Probability and Statistics for the Biosciences	3
<b>Credit Hours</b>		<b>14</b>

#### Spring

Biology Upper-Division Requirements (see section A.2)	3
Biology Upper-Division Requirements (see section A.2)	3

BIO 3053	Sophomore Research Experience (CURE) II	3
Select one of the following:		4
PHY 1603 & PHY 1611	Algebra-based Physics I and Algebra-based Physics I Laboratory	
or		
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	
Government-Political Science (core)		3
<b>Credit Hours</b>		<b>16</b>

#### Third Year

##### Fall

Biology Upper-Division Requirements (see section A.2)		3
BIO 3382	Sophomore Research Initiative Peer Mentor	2
COM 2113	Public Speaking	3
Select one of the following sequences:		4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	
PHY 1623 & PHY 1631	Algebra-based Physics II and Algebra-based Physics II Laboratory	
American History (core)		3
<b>Credit Hours</b>		<b>15</b>

##### Spring

Upper-Division Biology Elective (see section A.4)		3
Upper-Division Biology Electives (see section A.4)		3
BIO 1173	Introduction to Computational Biology	3
BIO 4002	Professional Development for Biology Careers	2
Government-Politics (core)		3
Creative Arts (core)		3
<b>Credit Hours</b>		<b>17</b>

#### Fourth Year

##### Fall

Upper-Division Biology Electives (see section A.4)		3
Upper-Division Biology Electives (see section A.4)		3
Free Upper-Division Elective (see section C)		3
American History (core)		3
Creative Arts (core)		3
<b>Credit Hours</b>		<b>15</b>

##### Spring

Upper-Division Biology Electives (see section A.4)		3
Upper-Division Biology Electives (see section A.4)		3
Free Upper-Division Elective (see section C)		3
Social and Behavioral (core)		3

Language, Philosophy, & Culture (core)	3
<b>Credit Hours</b>	<b>15</b>
<b>Total Credit Hours</b>	<b>120</b>

### B.S. in Biology – Recommended Four-Year Academic Plan for Concentration in Premedical Sciences

This course sequence guide is designed to assist students in completing their B.S. Degree in Biology with a Premedical Sciences Concentration.

*This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

#### First Year

Fall		Credit Hours
AIS 1263	AIS: Life and Health Sciences	3
BIO 1001	Introduction to Careers in the Health Professions	1
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)	4
CHE 1103 & CHE 1121	General Chemistry I and General Chemistry I Laboratory	4
WRC 1013	Freshman Composition I (core)	3
<b>Credit Hours</b>		<b>15</b>
Spring		
BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major)	4
CHE 1113 & CHE 1131	General Chemistry II and General Chemistry II Laboratory	4
WRC 1023	Freshman Composition II (core)	3
MAT 1073 or MAT 1093 or MAT 1193	Algebra for Scientists and Engineers or Precalculus or Calculus for the Biosciences	3
<b>Credit Hours</b>		<b>14</b>

#### Second Year

Fall		
BIO 2313	Genetics	3
BIO 2992	Medical Terminology	2
CHE 2603 & CHE 2612	Organic Chemistry I and Organic Chemistry I Laboratory	5
STA 1403	Probability and Statistics for the Biosciences	3
ENG 2413	Technical Writing (core)	3
<b>Credit Hours</b>		<b>16</b>
Spring		
BIO 3413 & BIO 3422	General Physiology and Physiology Laboratory	5
NDRB 3813	Cell Biology	3
CHE 3643	Organic Chemistry II	3

PSY 1013	Introduction to Psychology (core)	3
<b>Credit Hours</b>		<b>14</b>

#### Third Year

Fall		
BIO 3643 & BIO 3642	Advanced Physiology I and Clinical Anatomy Laboratory I	5
MMI 3013	Introduction to Clinical Medicine and Pathology	3
Select one of the following sequences:		4
PHY 1603 & PHY 1611	Algebra-based Physics I and Algebra-based Physics I Laboratory	
or		
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	

American History (core)	3
<b>Credit Hours</b>	<b>15</b>

#### Spring

BIO 3002	Professional Development for Pre-Medical Sciences	2
BIO 3653 & BIO 3652	Advanced Physiology II and Clinical Anatomy Laboratory II	5
MMI 4473	Advanced Clinical Medicine and Pathology	3
Choose one of the following two series of courses:		4
PHY 1623 & PHY 1631	Algebra-based Physics II and Algebra-based Physics II Laboratory	
or		
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	
Government-Political Science (core)	3	
<b>Credit Hours</b>		<b>17</b>

#### Fourth Year

Fall		
Upper-Division Biology Electives (recommended - MMI 3713 General Microbiology)		3
Upper-Division Biology Electives (see section 3)		2
BCH 3303	Essentials of Biochemistry	3
American History (core)	3	
Creative Arts (core)	3	
<b>Credit Hours</b>		<b>14</b>
Spring		
BIO 1173	Introduction to Computational Biology	3
NDRB 3433	Neurobiology	3
COM 2113	Public Speaking	3
Government-Political Science (core)	3	



Language, Philosophy, & Culture (core)	3
<b>Credit Hours</b>	<b>15</b>
<b>Total Credit Hours</b>	<b>120</b>

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

### B.S. in Biology – Recommended Four-Year Academic Plan for Concentration in Grade 7-12 Biology with Teaching Certification

This course sequence guide is designed to assist students in completing their UTSA undergraduate B.S. Degree in Biology with a Grade 7-12 Biology Teaching Certification. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

#### First Year

<b>Fall</b>		<b>Credit Hours</b>
AIS 1263	AIS: Life and Health Sciences	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)	4
CHE 1103	General Chemistry I	3
CHE 1121	General Chemistry I Laboratory	1
UTE 1111	Introduction to STEM Teaching Step 1	1
WRC 1013	Freshman Composition I (core)	3
<b>Credit Hours</b>		<b>15</b>

#### Spring

BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major)	4
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory	1
UTE 1122	Introduction to STEM Teaching Step 2	2
WRC 1023	Freshman Composition II (core)	3
STA 1053	Basic Statistics (core)	3
<b>Credit Hours</b>		<b>16</b>

#### Summer

American History (core)	3
Government-Political Science (core)	3
<b>Credit Hours</b>	<b>6</b>

#### Second Year

<b>Fall</b>		
BIO 2313	Genetics	3
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
CS 1173	Data Analysis and Visualization (core and major)	3
Select one of the following:		3
PHY 1603	Algebra-based Physics I	

<b>or</b>		
PHY 1943	Physics for Scientists and Engineers I	
UTE 3203	Knowing and Learning in Mathematics and Science	3
<b>Credit Hours</b>		<b>17</b>

#### Spring

Upper-Division Biology Electives (see section A.4)		3
Advanced Laboratory Options (see in section A.3)		2
Select one of the following:		3
PHY 1623	Algebra-based Physics II	
or		
PHY 1963	Physics for Scientists and Engineers II	
UTE 3213	Classroom Interactions	3
Social & Behavioral Sciences (core)		3
<b>Credit Hours</b>		<b>14</b>

#### Summer

American History (core)	3
Government-Political Science (core)	3
<b>Credit Hours</b>	<b>6</b>

#### Third Year

Fall		
Upper-Division Biology Electives (see section A.4)		3
Advanced Laboratory Options (see in section A.3)		2
BIO 3283	Ecology	3
MMI 3713	Microbiology	3
UTE 3023	Perspectives on Science and Mathematics	3
Credit Hours		14

#### Spring

BIO 3413	General Physiology	3
ESL 3083	Second Language Teaching and Learning for Grades 7-12	3
NDRB 3613	Brain and Behavior	3
LTED 3773	Reading and Writing Across the Disciplines-Grades 7-12	3
Language, Philosophy, & Culture (core)		3
<b>Credit Hours</b>		<b>15</b>

#### Fourth Year

<b>Fall</b>		
BIO 3323	Evolution	3
NDRB 3813	Cell Biology	3
SPE 3603	Introduction to Special Education	3
UTE 4203	Project-Based Instruction	3
Creative Arts (core)		3
<b>Credit Hours</b>		<b>15</b>

#### Spring

UTE 4646	Clinical Teaching	6
<b>Credit Hours</b>		<b>6</b>
<b>Total Credit Hours</b>		<b>124</b>

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

## Bachelor of Science Degree in Environmental Science

The Bachelor of Science (B.S.) Degree in Environmental Science is designed for students interested in studying environmental problems from a scientific perspective.

The minimum number of semester credit hours required for the B.S. degree in Environmental Science, including the Core Curriculum requirements, is 120. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and the required prerequisites must be completed with a grade of "C-" or better.

### Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. Degree in Environmental Science must fulfill University Core Curriculum requirements in the same manner as other students. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

MAT 1093 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

Two of the following courses may be used to satisfy the core requirement in Life and Physical Sciences as well as major requirements: CHE 1083, CHE 1093, ES 1113, ES 1123, ES 1213, ES 2013, ES 2023.

COM 2113 or ENG 2413 may be used to satisfy the core requirement in Component Area Option as well as major requirement.

### Core Curriculum Component Area Requirements (<http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degree requirements/core curriculum component area requirements/>)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
<b>Total Credit Hours</b>	<b>42</b>

### Degree Requirements

Code	Title	Credit Hours
<b>A. Required environmental science courses (54 hours of which six are in the core)</b>		
Must be completed with a grade of "C-" or better		
ES 1113 & ES 1111	Environmental Botany and Environmental Botany Laboratory	

ES 1123 & ES 1121	Environmental Zoology and Environmental Zoology Laboratory
ES 1213 & ES 1211	Environmental Geology and Environmental Geology Laboratory
ES 1314	Environmental Statistics
ES 2013 & ES 2021	Introduction to Environmental Science I and Introduction to Environmental Science I Laboratory
ES 2023 & ES 2031	Introduction to Environmental Science II and Introduction to Environmental Science II Laboratory
ES 2113	Fundamentals of Geographic Information Systems (GIS)
ES 3033 & ES 3042	Ecology and Ecology Laboratory
ES 3123 & ES 3121	Introduction to Soils and Introduction to Soils Laboratory
ES 3143 & ES 3141	Watershed Processes and Watershed Processes Laboratory
ES 3203	Environmental Law
ES 4103	Global Change
ES 4203	Environmental Assessment
ES 4212	Professional Development for Environmental Science Careers
ES 4253	Sources, Fate, and Transport of Chemicals in the Environment

### B. Required support courses (15 hours of which 6 are in the core) 15

Must be completed with a grade of "C-" or better

CHE 1083	Introduction to the Molecular Structure of Matter
CHE 1093	Introduction to Molecular Transformations
COM 2113	Public Speaking
ENG 2413	Technical Writing
MAT 1093	Precalculus

### C. Area of Study courses 21

Upper-division environmental science courses completed with a grade of "C-" or better

Twenty-one (21) semester credit hours of additional environmental science courses are required, of which fifteen (15) hours must be upper-division. While the degree is a general degree in environmental science, four areas of study have been identified within the B.S. degree program for students interested in conservation and restoration ecology, environmental management, natural resources and wildlife management, or aquatic sciences. Depending on their area of interest, students may select courses from the following areas of study:

#### Conservation and Restoration Ecology

Required Courses:

ES 4213	Conservation Biology
ES 4233	Restoration Ecology
Select five courses from the following:	
ES 3053	Environmental Remediation
ES 3073	Environmental Rhetoric and Technical Communication
ES 3103	Environmental Microbiology
ES 3113	Ichthyology

ES 3133	Oceanography
ES 3153	Environmental Chemistry
ES 3163	Ornithology
ES 3173	Mammalogy
ES 3183	Entomology
ES 3193	Herpetology
ES 3213	Wildflower Identification
ES 3223	Woody Plant Identification
ES 3233	Survey of Insects
ES 3253	R Coding in Environmental Science and Ecology
ES 3303	Sustainable Development
ES 3953	Topics in Environmental Science
ES 4023	Aquatic Ecology
ES 4113	Field Biology
ES 4123	Desert Biology
ES 4133	Natural Resource Policy and Administration
ES 4163	Renewable Energy
ES 4183	Environmental Toxicology
ES 4243	Wildlife Management
ES 4263	River Ecosystems
ES 4273	Fish Ecology
ES 4283	Plant-Soil-Microbe Interactions
ES 4293	Human Dimensions of Wildlife Management
ES 4303	Principles of Wildlife Management
ES 4503	Introduction to Environmental Risk Assessment
ES 4513	Advanced Environmental Risk Assessment
ES 4913	Independent Study
ES 4953	Special Studies in Environmental Science
ES 4963	Internship

#### Environmental Management

Required Courses:

ES 3053	Environmental Remediation
ES 3103	Environmental Microbiology
ES 4183	Environmental Toxicology
ES 4503	Introduction to Environmental Risk Assessment
ES 4513	Advanced Environmental Risk Assessment

Select two courses from the following:

ES 3073	Environmental Rhetoric and Technical Communication
ES 3113	Ichthyology
ES 3133	Oceanography
ES 3153	Environmental Chemistry
ES 3253	R Coding in Environmental Science and Ecology
ES 3303	Sustainable Development
ES 3953	Topics in Environmental Science
ES 4023	Aquatic Ecology
ES 4153	Introduction to Sustainability

ES 4163	Renewable Energy
ES 4173	Waste Water Treatment
ES 4243	Wildlife Management
ES 4263	River Ecosystems
ES 4283	Plant-Soil-Microbe Interactions
ES 4913	Independent Study
ES 4953	Special Studies in Environmental Science
ES 4963	Internship

#### Natural Resources and Wildlife Management

Required courses:

ES 4133	Natural Resource Policy and Administration
ES 4243	Wildlife Management

Select five courses from the following:

ES 3053	Environmental Remediation
ES 3073	Environmental Rhetoric and Technical Communication
ES 3103	Environmental Microbiology
ES 3113	Ichthyology
ES 3133	Oceanography
ES 3153	Environmental Chemistry
ES 3163	Ornithology
ES 3173	Mammalogy
ES 3183	Entomology
ES 3193	Herpetology
ES 3213	Wildflower Identification
ES 3223	Woody Plant Identification
ES 3233	Survey of Insects
ES 3253	R Coding in Environmental Science and Ecology
ES 3303	Sustainable Development
ES 3953	Topics in Environmental Science
ES 4023	Aquatic Ecology
ES 4113	Field Biology
ES 4123	Desert Biology
ES 4153	Introduction to Sustainability
ES 4163	Renewable Energy
ES 4173	Waste Water Treatment
ES 4183	Environmental Toxicology
ES 4213	Conservation Biology
ES 4233	Restoration Ecology
ES 4263	River Ecosystems
ES 4273	Fish Ecology
ES 4283	Plant-Soil-Microbe Interactions
ES 4293	Human Dimensions of Wildlife Management
ES 4303	Principles of Wildlife Management
ES 4913	Independent Study
ES 4953	Special Studies in Environmental Science
ES 4963	Internship

#### Aquatic Sciences

Required Courses:

ES 3113	Ichthyology
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ES 4023	Aquatic Ecology
ES 4273	Fish Ecology
Select four courses from the following:	
ES 3053	Environmental Remediation
ES 3073	Environmental Rhetoric and Technical Communication
ES 3103	Environmental Microbiology
ES 3133	Oceanography
ES 3153	Environmental Chemistry
ES 3163	Ornithology
ES 3173	Mammalogy
ES 3183	Entomology
ES 3193	Herpetology
ES 3213	Wildflower Identification
ES 3223	Woody Plant Identification
ES 3233	Survey of Insects
ES 3253	R Coding in Environmental Science and Ecology
ES 3303	Sustainable Development
ES 3953	Topics in Environmental Science
ES 4113	Field Biology
ES 4123	Desert Biology
ES 4133	Natural Resource Policy and Administration
ES 4153	Introduction to Sustainability
ES 4163	Renewable Energy
ES 4183	Environmental Toxicology
ES 4243	Wildlife Management
ES 4263	River Ecosystems
ES 4283	Plant-Soil-Microbe Interactions
ES 4293	Human Dimensions of Wildlife Management
ES 4303	Principles of Wildlife Management
ES 4503	Introduction to Environmental Risk Assessment
ES 4513	Advanced Environmental Risk Assessment
ES 4913	Independent Study
ES 4953	Special Studies in Environmental Science
ES 4963	Internship
<b>Total Credit Hours</b>	
<b>90</b>	

## Course Sequence Guide for B.S. Degree in Environmental Science

This course sequence guide is designed to assist students in completing their B.S. Degree in Environmental Science. *This is merely a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

## B.S. in Environmental Science – Recommended Four-Year Academic Plan

### First Year

Fall		Credit Hours
AIS 1263	AIS: Life and Health Sciences	3
ES 1123	Environmental Zoology (core and major)	3
ES 1121	Environmental Zoology Laboratory	1
MAT 1093	Precalculus (core)	3
WRC 1013	Freshman Composition I (core)	3
Creative Arts (core)		3
<b>Credit Hours</b>		<b>16</b>

### Spring

COM 2113	Public Speaking (core)	3
ES 1113	Environmental Botany (core)	3
ES 1111	Environmental Botany Laboratory	1
ES 1314	Environmental Statistics	4
WRC 1023	Freshman Composition II (core)	3
<b>Credit Hours</b>		<b>14</b>

### Second Year

#### Fall

ES 2013	Introduction to Environmental Science I	3
ES 2021	Introduction to Environmental Science I Laboratory	1
ES 2113	Fundamentals of Geographic Information Systems (GIS)	3
CHE 1083	Introduction to the Molecular Structure of Matter	3
POL 1013	Introduction to American Politics (core)	3
American History (core)		3
<b>Credit Hours</b>		<b>16</b>

#### Spring

ES 2023	Introduction to Environmental Science II	3
ES 2031	Introduction to Environmental Science II Laboratory	1
ES 1213	Environmental Geology	3
ES 1211	Environmental Geology Laboratory	1
CHE 1093	Introduction to Molecular Transformations	3
ENG 2413	Technical Writing	3
<b>Credit Hours</b>		<b>14</b>

### Third Year

#### Fall

ES 3123	Introduction to Soils	3
ES 3121	Introduction to Soils Laboratory	1
ES 3033	Ecology	3
ES 3042	Ecology Laboratory	2
POL 1133	Texas Politics and Society (core)	3
ES Area of Study Required		3
<b>Credit Hours</b>		<b>15</b>

**Spring**

ES 3143	Watershed Processes	3
ES 3141	Watershed Processes Laboratory	1
ES 4253	Sources, Fate, and Transport of Chemicals in the Environment	3
ES Area of Study Required		3
ES Area of Study Elective		3
American History (core)		3
<b>Credit Hours</b>		<b>16</b>

**Fourth Year****Fall**

ES 4103	Global Change (major)	3
ES 3203	Environmental Law (major)	3
ES Area of Study Elective (major)		3
ES Area of Study Elective (major)		3
Language, Philosophy & Culture (core)		3
<b>Credit Hours</b>		<b>15</b>

**Spring**

ES 4203	Environmental Assessment	3
ES 4212	Professional Development for Environmental Science Careers	2
ES Area of Study Elective		3
ES Area of Study Elective		3
Social and Behavioral Science (core)		3
<b>Credit Hours</b>		<b>14</b>
<b>Total Credit Hours</b>		<b>120</b>

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

## Bachelor of Arts Degree in Environmental Studies

The Bachelor of Arts (B.A.) degree in Environmental Studies is designed to provide students with a multidisciplinary educational approach regarding environmental issues and foster system-thinking skills. The degree reinforces the crucial role of interdisciplinary approaches in environmental problem-solving by emphasizing the sociocultural, historical, ethical, spiritual, economic, and political dimensions of complex environmental issues.

A minimum number of 120 semester credit hours is required for the B.A. in Environmental Studies, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and the required prerequisites must be completed with a grade of "C-" or better.

### Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.A. Degree in Environmental Studies must fulfill University Core Curriculum requirements in the same manner as other students. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

MAT 1093 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

Two of the following courses may be used to satisfy the core requirement in Life and Physical Sciences as well as major requirements: CHE 1083, CHE 1093, ES 1113, ES 1123, ES 1213, ES 2013, ES 2023.

COM 2113 may be used to satisfy the core requirement in Component Area Option as well as a major requirement.

### Core Curriculum Component Area Requirements (<http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degree/requirements/corecurriculumcomponentarearequirements/>)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
<b>Total Credit Hours</b>	<b>42</b>

## Degree Requirements

Code	Title	Credit Hours
<b>A. Required courses (67 hours, of which 12 are in the core)</b>		<b>67</b>
Must be completed with a grade of "C-" or better		
ANT 2053	Introduction to Cultural Anthropology	
CHE 1083	Introduction to the Molecular Structure of Matter	
ECO 2003	Economic Principles and Issues	
ENG 2413	Technical Writing	
ES 1003	Survey Topics in Environmental Studies	
ES 1113	Environmental Botany	
ES 1123	Environmental Zoology	
ES 1213	Environmental Geology	
ES 1314	Environmental Statistics	
ES 2013	Introduction to Environmental Science I	
ES 2023	Introduction to Environmental Science II	
ES 2113	Fundamentals of Geographic Information Systems (GIS)	
COM 2113	Public Speaking	
ENG 3383	Writing in Public and Professional Contexts	
ES 3203	Environmental Law	
ES 4133	Natural Resource Policy and Administration	
ES 4153	Introduction to Sustainability (Credit cannot be earned for ES 4153, GES 3003, and GES 3663)	
or GES 3003	Global Sustainability	
or GES 3663	Urban Sustainability in Global Context	
ES 4163	Renewable Energy	
ES 4203	Environmental Assessment	



ES 4103	Global Change (Credit can not be earned for GES 3753 and ES 4103)
or GES 3753	Climate Change
or ANT 3463	The Anthropology of Climate Change
MS 4333	Project Management
PAD 3043	Public and Nonprofit Financial Management

### B. Support Courses (17 hours) 17

Seventeen (17) semester credit hours of additional elective hours from the following list:

ANT 3303	Nature and Culture in Greater Amazonia
ANT 3213	Human Ecology Across the Ages
ANT 3223	Anthropology and the Environment
ANT 3333	Human Adaptability
ANT 3443	Anthropocene: Age of Extinction
ANT 3873	Food, Culture, and Society
ANT 4233	Primate Conservation
ANT 4153	The Urban Environment
ANT 4273	The Anthropology of Oil
ANT 4293	Plants, Animals, Humans, Oh My!: Thinking Beyond the Human
ANT 4503	Field Research Methods in Environmental Anthropology
COM 3023	Foundations of Communication
COM 3243	Persuasion
DS 4003	Introduction to Data Science
ENG 3813	Topics in Native American Literature
ENG 2453	Introduction to Environmental Humanities
ENG 4453	Topics in Social and Environmental Justice
ES 1111	Environmental Botany Laboratory
ES 1121	Environmental Zoology Laboratory
ES 1211	Environmental Geology Laboratory
ES 2021	Introduction to Environmental Science I Laboratory
ES 2031	Introduction to Environmental Science II Laboratory
ES 3033	Ecology
ES 3123	Introduction to Soils
ES 3143	Watershed Processes
ES 3163	Ornithology
ES 3173	Mammalogy
ES 3183	Entomology
ES 3193	Herpetology
ES 3213	Wildflower Identification
ES 3223	Woody Plant Identification
ES 4073	Social Science Research Methods
ES 4213	Conservation Biology
GES 3613	Conservation of Resources
GES 3713	Weather and Climate
GES 3723	Physiography
GES 3743	Biogeography
GES 3683	Sustainable Land Use Management
HIS 4223	Environmental History of the United States

HTH 4543	Environmental Health
MS 4333	Project Management
MS 3003	Visualization in Business Analytics
MOT 4143	Introduction to Project Management
PAD 3003	Fundraising in Nonprofit Agencies
PAD 3023	Introduction to Urban Management and Policy
PAD 3033	Introduction to Nonprofit Agencies
PAD 3053	Urban Economic Development
PAD 3113	Managing Nonprofit Organizations
PAD 3163	Quantitative Analysis for Public Administration and Policy
SOC 3223	Population Dynamics and Demographic Techniques

### C. Choose two (2) of the following courses 6

ES 4953	Special Studies in Environmental Science
ES 4963	Internship
ES 4113	Field Biology
ES 4123	Desert Biology
ES 4913	Independent Study (no more than six hours of Independent Study and Directed Research can be applied to your degree)
or ES 4911	Independent Study
or ES 4912	Independent Study
or ES 4991	Directed Research
or ES 4992	Directed Research
or ES 4993	Directed Research

**Total Credit Hours** **90**

## Course Sequence Guide for B.A. Degree in Environmental Studies

This course sequence guide is designed to assist students in completing their B.A. Degree in Environmental Studies. *This is merely a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Students may choose to take courses during Summer terms to reduce course loads during long semesters.

### B.A. in Environmental Studies – Recommended Four-Year Academic Plan

#### First Year

		Credit Hours
Fall		
AIS 1263	AIS: Life and Health Sciences	3
ES 1003	Survey Topics in Environmental Studies	3
ES 1123	Environmental Zoology (core and major)	3
WRC 1013	Freshman Composition I (core)	3
Mathematics (core)		3

**Credit Hours** **15**

#### Spring

CHE 1083	Introduction to the Molecular Structure of Matter	3
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ES 1113	Environmental Botany (core and major)	3
POL 1013	Introduction to American Politics (core)	3
WRC 1023	Freshman Composition II (core)	3
Language, Philosophy, & Culture (core)		3

**Credit Hours** **15**

## Second Year

### Fall

ENG 2413	Technical Writing (core and major)	3
ES 1314	Environmental Statistics	4
ES 2013	Introduction to Environmental Science I	3

Support Course (Section B)	3
American History (core)	3

**Credit Hours** **16**

### Spring

COM 2113	Public Speaking (required and core)	3
ECO 2003	Economic Principles and Issues	3
ES 1213	Environmental Geology	3
ES 2023	Introduction to Environmental Science II	3

Support Course (Section B)	3	
POL 1133	Texas Politics and Society (core)	3

**Credit Hours** **18**

## Third Year

### Fall

ANT 2053	Introduction to Cultural Anthropology (core)	3
ENG 3383	Writing in Public and Professional Contexts	3

ES 3203	Environmental Law	3
American History (core)		3
Creative Arts (core)		3

**Credit Hours** **15**

### Spring

ES 4163	Renewable Energy	3
MS 4333	Project Management	3
PAD 3043	Public and Nonprofit Financial Management	3

Support Course (Section B)	3
Support Course (Section B)	3

**Credit Hours** **15**

## Fourth Year

### Fall

ES 2113	Fundamentals of Geographic Information Systems (GIS)	3
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Elective 2

GES 3753 or ES 4103	Climate Change (Credit cannot be earned for both GES 3753 and ES 4103) or Global Change	3
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Internship, Independent Study, Field Course	3
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**Credit Hours** **11**

### Spring

ES 4133	Natural Resource Policy and Administration	3
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ES 4153	Introduction to Sustainability	3
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ES 4203	Environmental Assessment	3
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Support Course (Section B)	3
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Internship, Independent Study, Field Course	3
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**Credit Hours** **15**

**Total Credit Hours** **120**

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

## Bachelor of Science Degree in Multidisciplinary Science for Teaching

The Bachelor of Science (B.S.) Degree in Multidisciplinary Science for Teaching is designed for future secondary science teachers and gives students broad training across the sciences. This program integrates a specialized set of science courses, as well as 30 semester credit hours of coursework from the UTeachSA program, so that students can gain solid foundations in the life, physical, and chemical sciences and education fields to obtain the 7-12 Science Teaching Certification.

A minimum number of 120 semester credit hours is required for the B.S. in Multidisciplinary Science for Teaching, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work must be completed with a grade of "C-" or better.

### Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. Degree in Multidisciplinary Science for Teaching must fulfill University Core Curriculum requirements in the same manner as other students. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

MAT 1193 or STA 1053 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

Two of the following courses may be used to satisfy the core requirement in Life and Physical Sciences as well as major requirements: AST 1033, BIO 1203, BIO 1223, BIO 1223, PHY 1943, PHY 1943, or PHY 1963.

### Core Curriculum Component Area Requirements (<http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degree/requirements/corecurriculumcomponentarearequirements/>)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6

Social and Behavioral Sciences	3
Component Area Option	3
<b>Total Credit Hours</b>	<b>42</b>

## Degree Requirements

Code	Title	Credit Hours
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### A. Required science and mathematics courses

AST 1033	Exploration of the Solar System	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors	4
BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors	4
BIO 2313	Genetics	3
BIO 3413	General Physiology	3
CHE 1103 & CHE 1121	General Chemistry I and General Chemistry I Laboratory	4
CHE 1113 & CHE 1131	General Chemistry II and General Chemistry II Laboratory	4
ES 2013 & ES 2021	Introduction to Environmental Science I and Introduction to Environmental Science I Laboratory	4
ES 2023 & ES 2031	Introduction to Environmental Science II and Introduction to Environmental Science II Laboratory	4
ES 3033	Ecology	3
ES 3133	Oceanography	3
GEO 1103 & GEO 1111	Physical Geology and Physical Geology Laboratory	4
MAT 1193 or STA 1053	Calculus for the Biosciences Basic Statistics	3
ES 4023	Aquatic Ecology	3
Select one of the following options:		8

#### Option 1

PHY 1603 & PHY 1611	Algebra-based Physics I and Algebra-based Physics I Laboratory	
PHY 1623 & PHY 1631	Algebra-based Physics II and Algebra-based Physics II Laboratory	

#### Option 2

PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory <sup>1</sup>	
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory <sup>1</sup>	

### Education Courses

30 semester credit hours of UTeachSA and education courses		
ESL 3083	Second Language Teaching and Learning for Grades 7-12	3
LTED 3773	Reading and Writing Across the Disciplines- Grades 7-12	3
SPE 3603	Introduction to Special Education	3
UTE 1111	Introduction to STEM Teaching Step 1	1

UTE 1122	Introduction to STEM Teaching Step 2	2
UTE 3023	Perspectives on Science and Mathematics	3
UTE 3203	Knowing and Learning in Mathematics and Science	3
UTE 3213	Classroom Interactions	3
UTE 4203	Project-Based Instruction	3
UTE 4646	Clinical Teaching	6
<b>Total Credit Hours</b>		<b>87</b>

## Course Sequence for B.S. Degree in Multidisciplinary Science for Teaching

This course sequence guide is designed to assist students in completing their B.S. Degree in Multidisciplinary Science for Teaching. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

### B.S. in Multidisciplinary Science for Teaching – Recommended Four-Year Academic Plan

#### First Year

Fall		Credit Hours
AIS 1263	AIS: Life and Health Sciences	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)	4
WRC 1013	Freshman Composition I (core)	3
UTE 1111	Introduction to STEM Teaching Step 1	1
American History (core)		3
<b>Credit Hours</b>		<b>14</b>

#### Spring

BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major)	4
MAT 1193 or STA 1053	Calculus for the Biosciences (core and major) or Basic Statistics	3
WRC 1023	Freshman Composition II (core)	3
UTE 1122	Introduction to STEM Teaching Step 2	2
American History (core)		3
<b>Credit Hours</b>		<b>15</b>

#### Summer

CS 1173	Data Analysis and Visualization (core)	3
PSY 1013	Introduction to Psychology (core)	3
Government-Political Science (core)		3
Language, Philosophy & Culture (core)		3
<b>Credit Hours</b>		<b>12</b>

**Second Year****Fall**

CHE 1103 & CHE 1121	General Chemistry I and General Chemistry I Laboratory	4
ES 2013 & ES 2021	Introduction to Environmental Science I and Introduction to Environmental Science I Laboratory	4
UTE 3203	Knowing and Learning in Mathematics and Science	3
Creative Arts (core)		3

**Credit Hours** 14

**Spring**

CHE 1113 & CHE 1131	General Chemistry II and General Chemistry II Laboratory	4
GEO 1103 & GEO 1111	Physical Geology and Physical Geology Laboratory	4
UTE 3213	Classroom Interactions	3
Government-Political Science (core)		3

**Credit Hours** 14

**Third Year****Fall**

BIO 2313	Genetics	3
ES 2023 & ES 2021	Introduction to Environmental Science II and Introduction to Environmental Science I Laboratory	4
UTE 3023	Perspectives on Science and Mathematics	3
Select one of the following:		4
PHY 1603 & PHY 1611	Algebra-based Physics I and Algebra-based Physics I Laboratory	

or

PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	
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**Credit Hours** 14

**Spring**

ES 3033	Ecology	3
ES 3133	Oceanography	3
SPE 3603	Introduction to Special Education	3
UTE 4203	Project-Based Instruction	3
Select one of the following:		4
PHY 1623 & PHY 1631	Algebra-based Physics II and Algebra-based Physics II Laboratory	

or

PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	
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**Credit Hours** 16

**Fourth Year****Fall**

AST 1033	Exploration of the Solar System	3
BIO 3413	General Physiology	3
ES 4023	Aquatic Ecology	3
ESL 3083	Second Language Teaching and Learning for Grades 7-12	3
LTED 3773	Reading and Writing Across the Disciplines-Grades 7-12	3
<b>Credit Hours</b>		<b>15</b>

**Spring**

UTE 4646	Clinical Teaching	6
<b>Credit Hours</b>		<b>6</b>
<b>Total Credit Hours</b>		<b>120</b>

Note: Some courses are only offered once a year: Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

- Minor in Biology (p. 17)
- Minor in Environmental Science (p. 17)

## Minor in Biology

The Minor in Biology is open to all majors in the University. To declare a Minor in Biology or obtain advice, students should consult with their academic advisor. All students pursuing the minor must complete a minimum of 20 semester credit hours of Biology courses. It should be noted that students seeking a minor must also complete applicable support coursework in chemistry, computer science, physics, mathematics, and statistics, as needed to fulfill the normal prerequisites for any course listed below. All Biology courses and their prerequisites must be completed with a grade of "C-" or better, and students must achieve a grade point average of at least 2.0 on all work used to satisfy the requirements of the minor.

Code	Title	Credit Hours
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**A. Required courses**

BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors	4
BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors	4
BIO 2313	Genetics	3

**B. 3000- or 4000-level organized biology courses**

Three upper-division biology lecture courses. Excludes laboratory, independent study, research, and seminar courses. Substitutions are not allowed without approval of the Biology department.	9
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**Total Credit Hours** 20

## Minor in Environmental Science

The Minor in Environmental Science is open to all majors in the University. To declare a Minor in Environmental Science or obtain advice, students should consult with their academic advisor. All students pursuing the Minor in Environmental Science must complete 22 semester credit hours of Environmental Science courses, including a minimum of 6 hours

of upper-division courses. All coursework must be completed with a grade of "C-" or better.

Code	Title	Credit Hours
A. 16 semester credit hours of required courses:		16
ES 2013	Introduction to Environmental Science I	
ES 2021	Introduction to Environmental Science I Laboratory	
ES 2023	Introduction to Environmental Science II	
ES 2031	Introduction to Environmental Science II Laboratory	
ES 3033	Ecology	
ES 3042	Ecology Laboratory	
ES 3203	Environmental Law	
B. 6 additional semester credit hours from the following courses:		6
ES 3123	Introduction to Soils	
ES 3143	Watershed Processes	
ES 4133	Natural Resource Policy and Administration	
ES 4163	Renewable Energy	
ES 4203	Environmental Assessment	
ES 4213	Conservation Biology	
ES 4233	Restoration Ecology	
<b>Total Credit Hours</b>		<b>22</b>

## Biology (BIO) Courses

### BIO 1001. Introduction to Careers in the Health Professions. (1-0) 1 Credit Hour.

An exploration of careers in the health sciences for pre-medical sciences students. Topics include academic preparedness, course planning, effective use of advising and career preparation resources, and identification of opportunities for research, leadership, and clinical exposure. Restricted to Biology majors. Course Fee: STSI \$7.20; LRS1 \$15.4.

### BIO 1173. Introduction to Computational Biology. (3-0) 3 Credit Hours.

Prerequisite: MAT 1023. Introduction to computation for biologists, using a modern, open-source programming language such as Python or R. Programming concepts, including data types, functions, loops, and logic are explored within a context of realistic biological problems and data sets. Basic data visualization techniques are also explored. Generally offered: Fall, Spring, Summer. IUS1 \$15; LRS1 \$46.20; STSI \$21.60.

### BIO 1201. Biosciences I Laboratory for Science Majors. (0-3) 1 Credit Hour. (TCCN = BIOL 1106)

Prerequisite: Completion of or concurrent enrollment in one of the following: STA 1053, MAT 1023, MAT 1073, or higher. Corequisite: BIO 1203 for biology majors. This laboratory-based course accompanies BIO 1203, Biosciences I for Science Majors. Laboratory activities will reinforce the fundamental principles of living organisms, including physical and chemical properties of life, organization, function, evolutionary adaptation, and classification. Study and examination of the concepts of cytology, reproduction, genetics, and scientific reasoning are included. Course Fees: IUB1 \$10; L001 \$30; LRS1 \$15; STSI \$7.

### BIO 1203. Biosciences I for Science Majors. (3-0) 3 Credit Hours. (TCCN = BIOL 1306)

Prerequisite: Completion of or concurrent enrollment in one of the following: STA 1053, MAT 1023, MAT 1073, or higher. Corequisite: BIO 1201 is required for biology majors. This is the first course in a two-part introduction to the science of biology for students majoring in biology or interested in pre-health professions. Topics include biochemistry, cell biology, genetics, and molecular biology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (Formerly BIO 1113 and BIO 1404 in previous catalogs. Credit can only be earned for one of the following courses: BIO 1203, BIO 1404, or BIO 1113.) Generally offered: Fall, Spring, Summer. Course Fees: LRC1 \$12; LRS1 \$45; STSI \$21.

### BIO 1221. Biosciences II Laboratory for Science Majors. (0-3) 1 Credit Hour. (TCCN = BIOL 1107)

Prerequisite: BIO 1203 and BIO 1201 (or equivalent). Corequisite: BIO 1223 is required for biology majors. This laboratory-based course accompanies BIO 1223, Biosciences II for Science Majors. Laboratory activities will reinforce study of the diversity and classification of life, including animals, plants, protists, fungi, and prokaryotes. Special emphasis will be given to anatomy, physiology, ecology, and evolution of plants and animals. Course Fees: IUB1 \$10; L001 \$30; LRS1 \$15; STSI \$7.

### BIO 1223. Biosciences II for Science Majors. (3-0) 3 Credit Hours. (TCCN = BIOL 1307)

Prerequisite: BIO 1203. Corequisite: BIO 1221 is required for biology majors. This is the second course in a two-part introduction to the science of biology for students majoring in biology or interested in pre-health professions. Topics include evolutionary biology, biotic diversity, plant structure and function, and ecology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (Course formerly listed as BIO 1143, BIO 1413, and BIO 1414 in previous catalogs. Credit cannot be earned for more than one of the following: BIO 1143, BIO 1223, BIO 1413, BIO 1414, or ES 2013.) Generally offered: Fall, Spring, Summer. Course fees: LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

### BIO 1233. Contemporary Biology I. (3-0) 3 Credit Hours. (TCCN = BIOL 1308)

This is the first course in a two-part introduction to the science of biology for non-majors. This course focuses on the chemical basis of life, principles of inheritance, principles of evolution, and biodiversity. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. May not be applied to a B.S. degree in Biology or B.S. degree in Microbiology and Immunology. Generally offered: Fall, Spring. Course Fee: LRC1 \$12; LRS1 \$46.20; STSI \$21.60; DL01 \$75.

### BIO 1243. Contemporary Biology II. (3-0) 3 Credit Hours. (TCCN = BIOL 1309)

This is the second course in a two-part introduction to the science of biology for non-majors. This course focuses on evolution, animal and plant physiology, and ecology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. May not be applied to a B.S. degree in Biology or the B.S. degree in Microbiology and Immunology. Generally offered: Fall, Spring, Summer. Course Fees: DL01 \$75; LRC1 \$12; LRS1 \$46.20; STSI \$21.60.



**BIO 2043. Nutrition. (3-0) 3 Credit Hours. (TCCN = BIOL 1322)**

Prerequisite: BIO 1233 or BIO 1203 (formerly BIO 1404). In-depth study of nutrient classes in foods: their ingestion, digestion, absorption, and utilization by the human body. Clinical consequences of nutrient deficiency or excess, and Medical Nutrition Therapy to complement management of disease. (Formerly AHS 2043 in previous catalogs. Same as NDT 2043. Credit cannot be earned for more than one of the following courses: AHS 2043, BIO 2043, or NDT 2043.) Generally offered: Fall, Spring, Summer. Course Fee: LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**BIO 2051. Human Anatomy and Physiology Laboratory I. (0-3) 1 Credit Hour. (TCCN = BIOL 2101)**

Prerequisite: BIO 1203 or BIO 1233; completion of or concurrent enrollment in BIO 2053 is recommended. This laboratory supplements the BIO 2053 lecture. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. It is the first of a two-course laboratory sequence that uses both dissections of representative organisms and laboratory experimentation to study human anatomical systems and physiological processes. This course cannot count towards the BS Biology Degree. Generally offered: Fall, Spring, Summer. Course Fee: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20; DL01 \$25.

**BIO 2053. Human Anatomy and Physiology I. (3-0) 3 Credit Hours. (TCCN = BIOL 2301)**

Prerequisite: BIO 1203 or BIO 1233; concurrent enrollment in BIO 2051 is recommended. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. This is the first of a two-course sequence that provides an integrative study of the anatomy and physiology of the human body with an emphasis on the structure/function interrelationships between organ systems. Topics covered include cell and tissue biology and the integumentary, skeletal, muscular, and nervous systems. This course cannot count towards the BS Biology Degree. Generally offered: Fall, Spring, Summer. Course Fee: LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**BIO 2061. Human Anatomy and Physiology Laboratory II. (0-3) 1 Credit Hour. (TCCN = BIOL 2102)**

Prerequisite: BIO 2051; completion of or concurrent enrollment in BIO 2063 is recommended. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. This laboratory supplements the BIO 2063 lecture. It is the second of a two-course laboratory sequence that uses both dissections of representative organisms and laboratory experimentation to study human anatomical systems and physiological processes. (Same as BIO 3652. Credit cannot be earned for both BIO 2061 and BIO 3652. BIO 2061 cannot substitute for BIO 3422.) Generally offered: Fall, Spring, Summer. Course Fee: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20; DL01 \$25.

**BIO 2063. Human Anatomy and Physiology II. (3-0) 3 Credit Hours. (TCCN = BIOL 2302)**

Prerequisite: BIO 2053; concurrent enrollment in BIO 2061 is recommended. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. This is the second of a two-course sequence that provides an integrative study of the anatomy and physiology of the human body with an emphasis on the structure/function interrelationships between organ systems. Topics covered include the endocrine, digestive, respiratory, cardiovascular, lymphatic/immune, renal, and reproductive systems. Human growth and development will also be covered. (This course cannot count towards the BS Biology Degree.) Generally offered: Fall, Spring, Summer. Course Fee: LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**BIO 2073. Sophomore Research Experience (CURE) I. (1-6) 3 Credit Hours.**

Prerequisite: BIO 1203, BIO 1201, BIO 1223, and BIO 1221 with a grade of "C-" or better. Restricted to students who have completed 30 or more hours. The organizing principles of biology (such as molecular and cellular functions, reproduction, development, homeostatic mechanisms, and organismal physiology and behavior) are used within a comparative and evolutionary framework to train students in modern laboratory or field techniques, bioinformatics, experimental design, and interpretation of results. This is the first semester of a year-long course-based research experience (CURE) in which students complete an original research project and present results to stakeholders outside of the classroom. (Same as ES 2003. Credit cannot be earned for both BIO 2073 and ES 2003.) Generally offered: Fall. Course Fee: LRS1 \$46.20; STSI \$21.60; DL01 \$75; L001 \$30.

**BIO 2313. Genetics. (3-0) 3 Credit Hours. (TCCN = BIOL 2316)**

Prerequisite: BIO 1203 and BIO 1223. Principles governing the transmission of hereditary factors in plants and animals, with emphasis on molecular, biochemical, and population genetics. Generally offered: Fall, Spring, Summer. Course Fee: LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**BIO 2362. Molecular Genetics Laboratory. (0-6) 2 Credit Hours.**

Prerequisite: BIO 1203, BIO 1223, and CHE 1103. A study of techniques used to investigate the inheritance of genetic information at the molecular level. Students will gain an understanding of the structure, function and regulation of genes. Techniques will include; nucleic acid biochemistry, molecular cloning mutagenesis and bioinformatics. (Formerly BIO 2322. Credit cannot be earned for both BIO 2362 and BIO 2322.) Generally offered: Fall, Spring, Summer. Course Fee: L001 \$30; LRS1 \$30.80; STSI \$14.40; DL01 \$50.

**BIO 2953. Special Topics in Biology. (3-0) 3 Credit Hours.**

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics may be repeated for credit when the topics vary, but not more than 6 semester credit hours will apply to a bachelor's degree, regardless of discipline. No more than 6 semester credit hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a Bachelor of Science degree in Biology or Microbiology and Immunology. Course Fees: LRS1 \$46.20; STSI \$21.60.

**BIO 2992. Medical Terminology. (2-0) 2 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better. This course covers the language of medicine that will be used as a foundation for understanding upper-division undergraduate and graduate-level courses to follow. It will include pronunciation, definition, usage, and origins of medical terms. Medical terms presented will be used to identify signs, symptoms, diagnoses, and treatment options for selected pathologies. With these skills the student will be able to effectively interpret and communicate in a healthcare setting. Generally offered: Fall and Spring. Course Fee: LRS1 \$30.80; STSI \$14.40.

**BIO 3002. Professional Development for Pre-Medical Sciences. (2-0) 2 Credit Hours.**

Prerequisite: BIO 1001 or consent of the instructor; restricted to Biology majors within the Pre-medical Science concentration with at least 60 semester credit hours. Career development intended to enhance career readiness and marketability of students preparing to apply to health professional schools or employment in the health professions. Topics include elements of successful applications and development of student portfolios. This course has Differential Tuition. Course Fee: LRS1 \$30.80; STSI \$14.40.

**BIO 3013. Introduction to Clinical Medicine and Pathology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203, BIO 1223, BIO 2313, and BIO 2992. Introduction to concepts of human disease, diagnosis, and underlying pathology. (Same as MMI 3013. Credit cannot be earned for both BIO 3013 and MMI 3013.) Generally offered: Fall. This course has Differential Tuition.

**BIO 3043. UTeachSA Research Methods. (3-0) 3 Credit Hours.**

Prerequisite: This course is only open to students who are participating in the UTeachSA teacher preparation program. Students design and carry out independent inquiries, which they write up and present in the manner that is common in the scientific community. Inquiries incorporate mathematics and the various science disciplines to solve research problems. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. (Same as UTE 3043. Credit cannot be earned for both BIO 3043 and UTE 3043.) Generally offered: Fall. Spring. This course has Differential Tuition. Course Fee: LRS1 \$46.20; STSI \$21.60.

**BIO 3053. Sophomore Research Experience (CURE) II. (1-6) 3 Credit Hours.**

Prerequisites: Completion of BIO 2073 with a grade of "C-" or better. The organizing principles of biology (such as molecular and cellular functions, reproduction, development, homeostatic mechanisms, and organismal physiology and behavior) are used within a comparative and evolutionary framework to train students in modern laboratory or field techniques, bioinformatics, experimental design, and interpretation of results. This is the second semester of a year-long course-based research experience (CURE) in which students complete an original research project and present results to stakeholders outside of the classroom. (Same as ES 3003. Credit cannot be earned for both BIO 3053 and ES 3003.) Generally offered: Spring. This course has Differential Tuition. Course fees: LRS1 \$46.20; STSI \$21.60; L001 \$30.

**BIO 3073. Environmental Rhetoric and Technical Communication. (3-0) 3 Credit Hours.**

Prerequisite: ENG 2413; restricted to students who have completed 60 or more hours. This course focuses on rhetoric, ecology, and technical/scientific communication in order to develop interdisciplinary, team-based, and applied research projects. This advanced professional writing and rhetoric course will examine ecological communications as an archetypal example of specialized technical communication. (Same as ES 3073. Credit cannot be earned for both BIO 3073 and ES 3073.) Generally offered: Fall, Spring. This course has Differential Tuition.

**BIO 3113. Ichthyology. (2-3) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. This course will focus on form and function, behavior, life history, ecology, and key taxonomic characteristics of most of the orders of fishes. Field trips may be required. (Same as ES 3113. Credit cannot be earned for both BIO 3113 and ES 3113.) Generally offered: Spring. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$15.

**BIO 3123. Comparative Vertebrate Anatomy. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. Not recommended for pre-medical and pre-dental students. A comparative analysis of developmental and adult anatomy of vertebrates (including humans). Emphasis is placed on phylogenetic relationships between form, function, and evolution. Generally offered: Spring. This course has Differential Tuition. Course Fee: DL01 \$75.

**BIO 3183. Animal Nutrition. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203, BIO 1223, CHE 1103, and CHE 1113; restricted to students who have completed 60 or more hours. Comparative study of vertebrate nutrition with a focus on mammalian and avian species. The course will cover nutritional requirements and sources, nutrient metabolism, digestive physiology, and clinical consequences of nutrient deficiency and excess. This course has Differential Tuition. Course Fee: LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**BIO 3213. Animal Behavior. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. This course will introduce various approaches to the study of animals and their behavior in natural habitats. The course will examine basic principles derived from studying the evolution, ecology, and development of animals, and use these principles to explain how and why animals behave as they do in particular situations. Formerly NDRB 3213. Credit cannot be earned for both NDRB 3213 and BIO 3213. Generally offered: Spring, Summer. This course has Differential Tuition. Course Fee: DL01 \$75; STSI \$21.60; LRS1 \$46.20.

**BIO 3233. Survey of Insects. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. Course includes an introduction to basic insect biology, as well as in-depth coverage of insect systematics, including major orders and families. (Same as ES 3233. Credit cannot be earned for both BIO 3233 and ES 3233.) Generally offered: Spring even years. This course has Differential Tuition.

**BIO 3253. R Coding in Environmental Science and Ecology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1173 or CS 1173 with a grade of "C-" or better. This course will teach the management of environmental and ecological data using Program R. The focus will be on the structure and linguistics of data in R and how to integrate R into a data science workflow. (Same as ES 3253. Credit cannot be earned for both BIO 3253 and ES 3253.) Generally offered: Fall. This course has Differential Tuition. Course Fee: IUS1 \$15.

**BIO 3263. Woody Plant Identification. (1-4) 3 Credit Hours.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the woody plants emphasizing identification of the more common woody plants of Texas. Family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be a part of the course. (Same as ES 3223. Credit cannot be earned for both BIO 3263 and ES 3223.) Generally offered: Fall. This course has Differential Tuition. Course Fee: STFE \$40.

**BIO 3273. Wildflower Identification. (1-4) 3 Credit Hours.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the spring forbs emphasizing identification of the more common wildflowers of Texas. Family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be a part of the course. (Same as ES 3213. Credit cannot be earned for both BIO 3273 and ES 3213.) Generally offered: Spring. This course has Differential Tuition. Course Fee: STFE \$40.

**BIO 3283. Ecology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223, or equivalents. Examination of the interactions of biotic and abiotic systems, including interactions of plants, animals, and the environment. (Same as ES 3033. Credit cannot be earned for both BIO 3283 and ES 3033.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**BIO 3292. Ecology Laboratory. (0-6) 2 Credit Hours.**

Prerequisite: BIO 1201 and BIO 1221, or equivalents, are required; concurrent enrollment in BIO 3283 is recommended. A laboratory and field-oriented course emphasizing modern ecological techniques, including examinations of plant and animal populations and measurement of selected chemical and physical parameters. (Same as ES 3042. Credit cannot be earned for both BIO 3292 and ES 3042.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30; STFB \$40.

**BIO 3293. Mammalogy. (2-3) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123 with a grade of "C-" or better. A course covering various aspects of the biology of mammals, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as ES 3173. Credit cannot be earned for both ES 3173 and BIO 3293.) Generally offered: Fall of odd years. Differential Tuition: \$150. Course Fee: L001 \$10; STFE \$10.

**BIO 3303. Entomology. (2-3) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. A course covering various aspects of the biology of insects, including systematics, anatomy, physiology, evolution, behavior, ecology, and biogeography. (Same as ES 3183. Credit cannot be earned for both BIO 3303 and ES 3183.) Generally offered: Spring even years. Field trips may be required. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$40.

**BIO 3323. Evolution. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203, BIO 1223, and BIO 2313 with a grade of "C-" or better. This course is an introduction to the theories and mechanisms of evolution, focusing on evolutionary change of molecular, developmental, morphological, and behavioral traits. Topics include molecular evolution, natural selection and microevolution, phylogenetics, systematics, speciation, macroevolution, biogeography, and the fossil record. This course includes a diverse taxonomic focus, from prokaryotes to plants to animals. Discussion of the importance of evolutionary theory for diverse biological fields (from medicine to conservation) is included. This course has Differential Tuition. Course Fee: DL01 \$75.

**BIO 3333. Plants and Society. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. The importance of plants and plant-derived products to human health and wellbeing through the provision of food, pharmaceuticals, and other important natural products. (Formerly listed as BIO 2343 in previous catalogs. Credit cannot be earned for both BIO 3333 and BIO 2343.) Generally offered: Spring. This course has Differential Tuition.

**BIO 3343. Plant Cell Biology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. A comprehensive study of the molecular structures and functions of plant cells and their integration into the whole plant system. (Formerly titled "Plant Sciences.") Generally offered: Spring. This course has Differential Tuition.

**BIO 3353. Herpetology. (2-3) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better. A course covering various aspects of the biology of amphibians and reptiles, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as ES 3193. Credit cannot be earned for both ES 3193 and BIO 3353.) Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$40.

**BIO 3382. Sophomore Research Initiative Peer Mentor. (0-6) 2 Credit Hours.**

Prerequisite: BIO 3053, completion of the Sophomore Research Initiative, and consent of instructor. Student will be a peer mentor for students in the Sophomore Research Initiative (SRI) in a laboratory in which they were previously enrolled, and which they completed with a grade of "A" or "B". Students will work under the guidance of a graduate teaching assistant or laboratory coordinator. Besides assisting in the laboratory, students will be expected to attend group meetings associated with the laboratory, help with setup of the laboratories and complete a written assignment at the end of the semester. Students will not have any student grading responsibility. Can be repeated once for credit. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**BIO 3413. General Physiology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better. Physiology of systems of higher animals and plants, including circulation, regulation of body fluids, nervous system, muscle, sensory systems, and photosynthesis. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**BIO 3422. Physiology Laboratory. (0-6) 2 Credit Hours.**

Prerequisite: Completion of or concurrent enrollment in BIO 3413. Basic understanding of the physiological processes in living systems, employing methods and instruments of biological research. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**BIO 3483. Biology of Human Reproduction. (3-0) 3 Credit Hours.**

An in-depth look at human reproductive anatomy, physiology, and behavior. Topics to be considered include anatomy, sex differentiation, neuroendocrine physiology, conception and development, birth control, and sexually transmitted diseases. (Formerly BIO 1023 and BIO 2003 in previous catalogs. Credit can only be earned for one of the following: BIO 2003, BIO 1023, or BIO 3483.) Generally offered: Spring. This course has Differential Tuition. Course Fee: LRS1 \$46.20; STSI \$21.60.

**BIO 3523. Advanced Computational Biology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1173 or CS 1173 with a grade of "C-" or better. Development and application of computational approaches to biological questions, with focus on formulating interdisciplinary problems as computational problems and then solving these problems using algorithmic techniques. Generally offered: Spring. This course has Differential Tuition. Course Fee: IUS1 \$15.

**BIO 3642. Clinical Anatomy Laboratory I. (0-6) 2 Credit Hours.**

Prerequisite: BIO 2992 and BIO 3413 with a grade of "C-" or better; completion of or concurrent enrollment in BIO 3643. Designed for pre-medical and pre-dental students. Not recommended for pre-nursing and allied health students. This is the first laboratory course in a two part series that teaches the structure of the human body at a level required for clinical medicine. Generally offered: Fall. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**BIO 3643. Advanced Physiology I. (3-0) 3 Credit Hours.**

Prerequisite: BIO 2992 and BIO 3413 with a grade of "C-" or better; completion of or concurrent enrollment in BIO 3642. This is the first lecture course in a two part series that teaches the structure and functions of the human body at a level required for clinical medicine. The course covers normal physiology, as well as selected diseases. This course will cover foundational basics on the cell, body fluids, the autonomic nervous system, and endocrine system. The ultimate goal is for students to develop an understanding of the integrated functions of the normal body and "problem solving" and "critical thinking" skills in evaluating clinical situations. Generally offered: Fall. This course has Differential Tuition.

**BIO 3652. Clinical Anatomy Laboratory II. (0-6) 2 Credit Hours.**

Prerequisite: BIO 3643 and BIO 3642 with a grade of "C-" or better; completion of or concurrent enrollment in BIO 3653. Designed for pre-medical and pre-dental students. Not recommended for pre-nursing and allied health students. This is the second laboratory course in a two part series that teaches the structure of the human body at a level required for clinical medicine. Generally offered: Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**BIO 3653. Advanced Physiology II. (3-0) 3 Credit Hours.**

Prerequisite: BIO 3643 and BIO 3642 with a grade of "C-" or better; completion of or concurrent enrollment in BIO 3652. Designed for pre-medical and pre-dental students. Not recommended for pre-nursing and allied health students. This is the second lecture course in a two part series that teaches the structure and functions of the human body at a level required for clinical medicine. The course covers cardiovascular, respiratory, renal, and gastrointestinal; with a final integration section which applies the physiological principles learned to special situations. The ultimate goal is for students to develop an understanding of the integrated functions of the normal body and "problem solving" and "critical thinking" skills in evaluating clinical situations. Generally offered: Spring. This course has Differential Tuition.

**BIO 4002. Professional Development for Biology Careers. (2-0) 2 Credit Hours.**

Prerequisite: Restricted to Biology majors with at least 90 credit hours. A semester-long professional development seminar aimed at enhancing students' academic training, career readiness, and marketability for biology careers. This course has Differential Tuition.

**BIO 4033. Conservation Biology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 3283 or ES 3033 or equivalents. Class topics will include identifying and/or explaining biological and ecological principles central to conservation biology; critically evaluating reasons for conserving ecosystems and ecosystem services; explaining how the human dimension (human behavior, economics, land use, and others) affects the conservation of species; evaluating strategies and tools used to conserve species or habitat at risk of extinction or destruction; demonstrating skills in science communication: articulate and communicate a breadth of knowledge of conservation biology, conservation challenges, policies, and programs. (Same as BIO 4033. Credit cannot be earned for both ES 4213 and BIO 4033.) Generally offered: Spring. This course has Differential Tuition.

**BIO 4043. Desert Biology. (2-3) 3 Credit Hours.**

Prerequisite: A minimum of 60 semester credit hours or consent of instructor. Corequisites: BIO 4233 and BIO 4241. A multi-week, off-campus, field-oriented course focused on the study of the deserts of the world, emphasizing the deserts of the American Southwest. Adaptations of plants and animals and their responses to desert conditions, as well as examinations of desert climatic patterns, geology, and natural history. (Same as ES 4123. Credit cannot be earned for both BIO 4043 and ES 4123.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15.

**BIO 4053. Wildlife Ecology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 3283 with a grade of "C-" or better. Major environmental factors affecting wildlife, structure and behavior of wildlife populations, regional wildlife communities and their conservation. Field studies will allow students to observe and apply classroom topics. (Same as ES 4243. Credit cannot be earned for both BIO 4053 and ES 4243.) Generally offered: Fall. This course has Differential Tuition.

**BIO 4063. Ornithology. (2-3) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better. A course covering various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as ES 3163. Credit cannot be earned for both ES 3163 and BIO 4063.) Generally offered: Spring of even years. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$40.

**BIO 4103. Social Science Research Methods. (3-0) 3 Credit Hours.**

Prerequisite: A minimum of 60 semester credit hours, or consent of the instructor. The objective of this course is to introduce social science research methods which are: (a) commonly used in biological research (e.g., human dimensions research, public lands management, medical research) and (b) essential for research directly engaging stakeholders and the public (e.g., citizen science or community-based research). The course engages ethical and legal obligations related to human-subjects research. It introduces 5 different data collection methods: surveys, interviews, focus groups, ethnographic and community-based research methods, and audiovisual/textual artifact analysis (e.g., photographs, etc.). Assignments emphasize writing skills specific to these methods and provide opportunities to actively engage different data collection methods (e.g., via field observations). This course has Differential Tuition.

**BIO 4123. Internship in the Biological Sciences. (0-0) 3 Credit Hours.**

Prerequisite: Junior or senior status, in Academic Good Standing, and approval from the employer, the instructor, the Department Chair, and the Associate Dean for Undergraduate Studies; form available on the College of Sciences website. The opportunity for a semester-long work experience in a private business or public agency in a position related to the student's field of study. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**BIO 4233. Field Biology. (3-0) 3 Credit Hours.**

Prerequisite: A minimum of 60 semester credit hours or consent of instructor. Corequisites: BIO 4241 and BIO 4043. A multi-week, off-campus, field-oriented course offering the opportunity for practical experience observing, collecting, and identifying plants and animals of the American Southwest. (Same as ES 4113. Credit cannot be earned for both BIO 4233 and ES 4113.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.



**BIO 4241. Field Biology Laboratory. (0-3) 1 Credit Hour.**

Prerequisite: A minimum of 60 semester credit hours, or consent of instructor. Corequisites: BIO 4233 and BIO 4043. A multi-week, off-campus, field-oriented course offering the opportunity for practical experience observing, collecting, and identifying plants and animals of the American Southwest. (Same as ES 4111. Credit cannot be earned for both BIO 4241 and ES 4111.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**BIO 4263. River Ecosystems. (3-0) 3 Credit Hours.**

Prerequisite: BIO 3283 or ES 3033 with a grade of "C-" or better, and ES 3143. This course examines the physical, chemical, and biological factors that determine biodiversity and the structure and function of aquatic and riparian ecosystems. Key ecological, hydrological, and physicochemical concepts and their application to environmental concerns are covered. (Same as ES 4263. Credit cannot be earned for both BIO 4263 and ES 4263.) Generally offered: Spring of even years. This course has Differential Tuition.

**BIO 4273. Fish Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 2013, ES 2021, ES 2023, ES 2031, or equivalents. A study of the biotic and abiotic factors affecting the diversity and distribution of fishes, with a focus on North American and Texas freshwater fishes. This course is split into lecture-style classes focusing on the aforementioned topics and field trip classes during which students will learn how to implement basic survey methods, identify common freshwater fishes, and collect and analyze data. Field trips may be required. (Same as ES 4273. Credit cannot be earned for both BIO 4273 and ES 4273.) Generally offered: Fall even years. This course has Differential Tuition. Course Fee: IUS1 \$15.

**BIO 4283. Plant-Soil-Microbe Interactions. (3-0) 3 Credit Hours.**

Prerequisite: ES 3123 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. This course focuses on the microbial groups which live in soils and among plant species and the methodologies used to understand their interaction. (Same as ES 4283. Credit cannot be earned for both BIO 4283 and ES 4283.) Generally offered: Spring of odd years. This course has Differential Tuition.

**BIO 4303. Aquatic Ecology. (3-0) 3 Credit Hours.**

This course focuses on the physical, chemical, and biological processes in groundwater, wetlands, streams, rivers, lakes, and reservoirs. Anthropogenic impacts will be discussed and evaluated. Students need to have a basic knowledge of ecology and chemistry. Students will learn about the physical and chemical aspects of aquatic systems and the life cycles and adaptations of aquatic organisms. After completion of the course, students will have a basic understanding of aquatic systems and the impacts of human activities on aquatic ecosystems. This course has Differential Tuition.

**BIO 4313. Plant Physiological Ecology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 3283 with a grade of "C-" or better. Survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as ES 4033. Credit cannot be earned for both BIO 4313 and ES 4033.) Generally offered: Fall of odd years. This course has Differential Tuition.

**BIO 4323. Restoration Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 or BIO 3283, or equivalents. Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. (Same as ES 4233. Credit cannot be offered for both BIO 4323 and ES 4233.) Generally offered: Spring. This course has Differential Tuition.

**BIO 4453. Endocrinology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 or BIO 1233 with a grade of "C-" or better; restricted to students who have completed 60 or more hours. Topics include molecular mechanisms of hormone action in reproductive physiology, growth, development, and defects in hormonal regulation underlying clinically important syndromes (e.g., diabetes, hypertension, osteoporosis, and cancer). This course has Differential Tuition.

**BIO 4643. Medicinal Plants. (3-0) 3 Credit Hours.**

Prerequisite: BIO 1203 and BIO 1223 with a grade of "C-" or better; restricted to students who have completed 60 or more hours; a course in biochemistry is recommended. Ethnobotanical, biochemical, and pharmacological aspects of some of our most important plant-derived drugs. Generally offered: Fall. This course has Differential Tuition.

**BIO 4911. Independent Study. (0-0) 1 Credit Hour.**

Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923, and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**BIO 4912. Independent Study. (0-0) 2 Credit Hours.**

Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923, and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**BIO 4913. Independent Study. (0-0) 3 Credit Hours.**

Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923, and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.



**BIO 4923. Laboratory Research: Biology Concentrations. (0-0) 3 Credit Hours.**

Prerequisite: Permission in writing (form available in the Biology Department Office) from the faculty mentor, the student's advisor, the Department Chair, and the Dean of the College. Supervised laboratory research mentored by a faculty member engaged in active research within the student's designated area of concentration. May be repeated for credit, but no more than 6 semester credit hours will apply to a bachelor's degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923, and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**BIO 4951. Special Studies in Biology. (1-0) 1 Credit Hour.**

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. No more than 6 semester credit hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a B.S. degree in Biology or Microbiology and Immunology. This course has Differential Tuition.

**BIO 4953. Special Studies in Biology. (3-0) 3 Credit Hours.**

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. No more than 6 semester hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a B.S. degree in Biology or Microbiology and Immunology. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course fee: DL01 \$75.

**BIO 4993. Directed Research. (0-0) 3 Credit Hours.**

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit with approval, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 4911-3, BIO 4923, and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring. This course has Differential Tuition.

## Environmental Sciences (ES) Courses

**ES 1003. Survey Topics in Environmental Studies. (3-0) 3 Credit Hours.**

A broad-based survey course intended to provide a comprehensive introduction to the multidisciplinary field of environmental studies. This course examines the ecological, social, political, and economic aspects of contemporary environmental issues from an interdisciplinary perspective. May be applied toward the Core Curriculum Component Area Requirement in Social and Behavioral Sciences. Generally offered: Fall and Spring. Course Fee: LRS1 \$46.20; STSI \$21.60.

**ES 1111. Environmental Botany Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 1111)**

Laboratory studies to accompany Environmental Botany Lecture. Selected laboratories pertaining to the structure and function of plants. Generally offered: Fall and Spring. Course Fees: IUS1 \$15; L001 \$20; LRS1 \$15.40; STSI \$7.20.

**ES 1113. Environmental Botany. (3-0) 3 Credit Hours. (TCCN = BIOL 1311)**

Study of structure and function of plant cells, tissues, and organs. Includes an evolutionary survey and life histories of the following representative groups: algae, fungi, mosses, liverworts, ferns, and seed producing organisms. Plant reproductive and functional interactions with their environment and with humans. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: IUS1 \$15; LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

**ES 1121. Environmental Zoology Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 1113)**

Laboratory studies to accompany ES 1123 Environmental Zoology Lecture. Selected laboratories pertaining to animal taxonomy, genetics, anatomy, physiology, and ecology. Generally offered: Fall and Spring. Course Fee: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20.

**ES 1123. Environmental Zoology. (3-0) 3 Credit Hours. (TCCN = BIOL 1313)**

An introduction to basic concepts in biology through the study of the major lineages of invertebrate and vertebrate animals, with emphasis on the structure and function of organ systems in an evolutionary context. Topics covered will include basic cell structure and function, genetics, systematics, evolution, animal groups, and selected body systems. Functional interactions of animals with humans and the environment will also be studied. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fee: LRC1 \$12; LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**ES 1211. Environmental Geology Laboratory. (0-3) 1 Credit Hour. (TCCN = GEOL 1105)**

Laboratory studies to accompany Environmental Geology Lecture. Selected laboratories pertaining to urban and regional land use planning. Generally Offered: Fall and Spring. Course Fees: IUS1 \$15; L001 \$30; LRS1 \$15.40; STFE \$40; STSI \$7.20.

**ES 1213. Environmental Geology. (3-0) 3 Credit Hours. (TCCN = GEOL 1305)**

The earth as a habitat. Interrelationships between humans and the environment. Geologic factors in urban and regional land use planning. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

**ES 1314. Environmental Statistics. (3-3) 4 Credit Hours. (TCCN = MATH 1442)**

Collection, analysis, presentation, and interpretation of environmental data, and probability. Analysis includes descriptive statistics, correlation and regression, confidence intervals and hypothesis testing. Use of appropriate technology, including statistical software. Generally offered: Fall and Spring. Course Fees: IUS1 \$15; LRS1 \$61.60; STSI \$28.80.

**ES 2003. Sophomore Research Experience (CURE) I. (1-4) 3 Credit Hours.**

Prerequisite: ES 2013, ES 2023, ES 2021, and ES 2031 with a grade of at least a 'C-'; Restricted to students who have completed 30 or more hours. The organizing principles of environmental science are used to train students in modern laboratory or field techniques, bioinformatics, experimental design, and interpretation of results. This is the first semester of a year-long course-based research experience (CURE) in which students complete an original research project and present results to stakeholders outside of the classroom. (Same as BIO 2073. Credit cannot be earned for both BIO 2073 and ES 2033.) Generally offered: Fall. Course Fee: LRS1 \$46.20; STSI \$21.60; L001 \$30.

**ES 2013. Introduction to Environmental Science I. (3-0) 3 Credit Hours. (TCCN = ENVR 1301)**

An introduction to environmental science, including scientific principles, concepts, and methods needed to understand the interactions of the biotic (living) components in the natural world. Topics covered include environmental and scientific literacy, ecology, evolution and biodiversity, human populations and environmental health, and resource management and environmental policies. Core Curriculum skills, including critical thinking, quantitative skills, teamwork, and communication, are emphasized. (TCCN = ENVR 1301). May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fee: DL01 \$75; LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

**ES 2021. Introduction to Environmental Science I Laboratory. (0-3) 1 Credit Hour. (TCCN = ENVR 1101)**

Prerequisite: Concurrent enrollment in ES 2013 is recommended. Qualitative and quantitative methods in the study of biotic environmental systems. Generally offered: Fall, Spring. Course Fees: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20.

**ES 2023. Introduction to Environmental Science II. (3-0) 3 Credit Hours. (TCCN = ENVR 1302)**

An introduction to environmental science, including scientific principles, concepts, and methods needed to understand the interactions of the abiotic (non-living) components of the natural world. Topics covered include waste and water resources, land and food resources, conventional energy and alternatives, and air quality and climate change. Core Curriculum skills, including critical thinking, quantitative skills, teamwork, and communication, are emphasized. (TCCN = ENVR 1302). May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fee: LRC1 \$12; LRS1 \$46.20; STSI \$21.60; DL01 \$75.

**ES 2031. Introduction to Environmental Science II Laboratory. (0-3) 1 Credit Hour. (TCCN = ENVR 1102)**

Prerequisite: Concurrent enrollment in ES 2023 is recommended. Qualitative and quantitative methods in the study of abiotic environmental systems. Generally offered: Fall, Spring. Course Fees: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20.

**ES 2113. Fundamentals of Geographic Information Systems (GIS). (3-0) 3 Credit Hours.**

This course will be a basic introduction to the concepts and techniques of utilizing a Geographic Information System (GIS) to study and model environmental issues. This course will be taught hands-on using Windows-based industry-standard software. The goal of this course is that by the time of completion, students will have the competency of entry-level position skills. The theory and skills will include but are not limited to map-making best practices, data management, editing layers, features, databases, basic geoprocessing, GPS theory, and other GIS components. (Same as GEO 2113. Credit cannot be earned for both ES 2113 and GEO 2113.) Course Fee: IUS1 \$15; LRS1 \$46.20; STSI \$21.60.

**ES 3003. Sophomore Research Experience (CURE II). (1-6) 3 Credit Hours.**

Prerequisite: ES 2003 with a grade of at least a 'C-'. The organizing principles of environmental science are used to train students in modern laboratory or field techniques, bioinformatics, experimental design, and interpretation of results. This is the second semester of a year-long course-based research experience (CURE) in which students complete an original research project and present results to stakeholders outside of the classroom. (Same as BIO 3053. Credit can be earned for both ES 3003 and BIO 3053.) Generally offered: Spring. This course has Differential Tuition.

**ES 3033. Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123, or equivalents. Examination of the interactions of biotic and abiotic systems, including interactions of plants, animals, and the environment. (Same as BIO 3283. Credit cannot be earned for both ES 3033 and BIO 3283.) Generally offered: Fall, Spring. This course has Differential Tuition.

**ES 3042. Ecology Laboratory. (0-6) 2 Credit Hours.**

Prerequisite: ES 2021 and ES 2031, or equivalents; concurrent enrollment in ES 3033 is recommended. A laboratory and field-oriented course emphasizing modern ecological techniques, including examining plant and animal populations and measuring selected chemical and physical parameters. (Same as BIO 3292. Credit cannot be earned for both ES 3042 and BIO 3292.) Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30; STFE \$40.

**ES 3053. Environmental Remediation. (3-0) 3 Credit Hours.**

Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. This course will focus on the fundamentals associated with environmental remediation in relation to the overall environmental quality and protection. Topics covered include contaminant fate and transport; physical, chemical, and biological processes/characteristics of the air, soil, and water; remediation/restoration methods; environmental monitoring; environmental assessments; environmental regulations; and water/wastewater treatment. (Formerly ES 3054. Credit cannot be earned for both ES 3053 and ES 3054.) Generally offered: Spring. This course has Differential Tuition.

**ES 3073. Environmental Rhetoric and Technical Communication. (3-0) 3 Credit Hours.**

Prerequisite: ENG 2413. Restricted to students who have completed 60 or more hours. This course focuses on rhetoric, ecology, and technical/scientific communication in order to develop interdisciplinary, team-based, and applied research projects. This advanced professional writing and rhetoric course will examine ecological communications as an archetypal example of specialized technical communication. (Same as BIO 3073. Credit cannot be earned for both ES 3073 and BIO 3073.) Generally offered: Fall, Spring. This course has Differential Tuition.

**ES 3103. Environmental Microbiology. (2-3) 3 Credit Hours.**

Prerequisite: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents; or consent of instructor. This course will survey environmental microbiology and emphasize microbial interactions in terrestrial and aquatic environments as well as the fate of microbial pathogens. Topics covered include microbial environments, detection of bacteria and their activities in the environment, microbial biogeochemical cycling, bioremediation of organic and inorganic pollutants, and water quality. (Formerly ES 3104. Credit can only be earned for one of the following: ES 3103, ES 3104, or BIO 3713.) Generally offered: Fall. This course has Differential Tuition.

**ES 3113. Ichthyology. (2-3) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123, or equivalents. Study of fishes, and includes a wide range of topics, including taxonomy, systematics, biogeography, anatomy and physiology, and behavior and ecology. This course will focus on form and function, behavior, life history, ecology, and key taxonomic characteristics of most orders of fishes. Field trips may be required. Same as BIO 3113, credit cannot be earned for both BIO 3113 and ES 3113. Generally offered: Spring. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$15.

**ES 3121. Introduction to Soils Laboratory. (0-3) 1 Credit Hour.**

Prerequisites: CHE 1083 and CHE 1093, or equivalents. Laboratory exercise and field trips designed to develop student competency in soil description, analysis, and assessment. Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**ES 3123. Introduction to Soils. (3-0) 3 Credit Hours.**

Prerequisites: CHE 1083 and CHE 1093, or equivalents. A study of soil properties and processes and relationships to land use, plant growth, environmental quality, and society. Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 3133. Oceanography. (3-0) 3 Credit Hours.**

Prerequisite: ES 1213 or equivalent. Description of the oceans. Emphasis on relations of biology, chemistry, geology, and physics in marine environments. Examination of relationships and interactions at macro and micro scales in the ocean. Field trips may be required. (Same as GEO 3163. Credit cannot be earned for both ES 3133 and GEO 3163.) Generally Offered: Spring of even years. This course has Differential Tuition.

**ES 3141. Watershed Processes Laboratory. (0-3) 1 Credit Hour.**

Prerequisite: ES 2013, ES 2023, ES 1213, and ES 2113, or equivalents. Laboratory exercises and field trips to local waterways designed to practice application of concepts, including watershed assessment and watershed management. Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30; STFE \$40.

**ES 3143. Watershed Processes. (3-0) 3 Credit Hours.**

Prerequisite: ES 2013, ES 2023, ES 1213, and ES 2113, or equivalents. This course focuses on watershed processes concepts and application of concepts, including aquatic ecosystem management and restoration. Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 3153. Environmental Chemistry. (3-0) 3 Credit Hours.**

Prerequisite: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. This course explores the chemistry of the environment, the chemistry underlying environmental problems, and solutions to environmental problems. Emphasis is placed on thermodynamics and kinetics of reaction cycles; sources, sinks, and transport of chemical species; and quantitation of chemical species. Examples are selected from the chemistry of natural and contaminated air, water, and soil. (Same as CE 4613. Credit cannot be earned for both ES 3153 and CE 4613.) Generally offered: Spring. This course has Differential Tuition. Course Fee: LRS1 \$46.20; STSI \$21.60.

**ES 3163. Ornithology. (2-3) 3 Credit Hours.**

Prerequisite: ES 2013 and ES 2023, or equivalents. A course covering various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 4063. Credit cannot be earned for both ES 3163 and BIO 4063.) Generally offered: Spring of even years. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$10.

**ES 3173. Mammalogy. (3-3) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. A course covering various aspects of the biology of mammals, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3293. Credit cannot be earned for both ES 3173 and BIO 3293.) Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$10.

**ES 3183. Entomology. (2-3) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. A course covering various aspects of the biology of insects, including systematics, anatomy, physiology, evolution, behavior, ecology, and biogeography. (Same as BIO 3303. Credit cannot be earned for both BIO 3303 and ES 3183.) Generally offered: Spring even years. Field trips may be required. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$40.

**ES 3193. Herpetology. (2-3) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. A course covering various aspects of the biology of amphibians and reptiles, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3353. Credit cannot be earned for both ES 3193 and BIO 3353.) Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$10.

**ES 3203. Environmental Law. (3-0) 3 Credit Hours.**

Present-day environmental enabling acts and regulations will be covered, with emphasis on federal acts, such as the National Environmental Policy Act, Clean Water Act, Resource Conservation and Recovery Act, and associated regulations. Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 3213. Wildflower Identification. (1-6) 3 Credit Hours.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the spring forbs emphasizing identification of the more common wildflowers of Texas. Family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included in the course. (Same as BIO 3273. Credit cannot be earned for both ES 3213 and BIO 3273.) Generally offered: Spring. This course has Differential Tuition. Course Fee: STFE \$40.

**ES 3223. Woody Plant Identification. (1-6) 3 Credit Hours.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the woody plants emphasizing identification of the more common woody plants of Texas. Family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included in the course. (Same as BIO 3263. Credit cannot be earned for both ES 3223 and BIO 3263.) Generally offered: Fall. This course has Differential Tuition. Course Fee: STFE \$40.

**ES 3233. Survey of Insects. (3-0) 3 Credit Hours.**

Prerequisite: ES 2013 and ES 2023 with a grade of at least a C-, and junior or senior status. Insect systematics, including major orders and families. (Same as BIO 3233. Credit cannot be earned for both BIO 3233 and ES 3233.) Generally offered: Spring even years. This course has Differential Tuition.

**ES 3253. R Coding in Environmental Science and Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 2113. Restricted to students who have completed 60 or more hours. This course will teach the management of environmental and ecological data using Program R. The focus will be on the structure and linguistics of data in R and how to integrate R into a data science workflow. (Same as BIO 3253. Credit cannot be earned for both ES 3253 and BIO 3253.) Generally offered: Spring even years. This course has Differential Tuition.

**ES 3303. Sustainable Development. (3-0) 3 Credit Hours.**

Prerequisite: ES 2013 and ES 2023. Restricted to students who have completed 60 or more hours. This course will focus on addressing the challenges of sustainability and development with actionable knowledge for innovating solutions to the world's most pressing problems like climate change, poverty and inequality, and biodiversity loss and ecosystem degradation. Generally offered: Spring even years. This course has Differential Tuition.

**ES 3313. Advanced Geographic Information Systems (GIS). (3-0) 3 Credit Hours.**

Prerequisite: ES 1314 and ES 2113 or equivalents. This course will expand on student GIS skills from merely 'making maps' to geospatial data analysis and using GIS as a problem-solving tool. Introductory skills such as data management, layer editing, layout creation, and knowledge of map design, projections, and error will be assumed. This course will cover advanced analysis tools focusing on advanced spatial and 3D analysis and other geoprocessing techniques. Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: IUS1 \$15.

**ES 3953. Topics in Environmental Science. (3-0) 3 Credit Hours.**

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Field trips may be required. May be repeated for credit when topics vary. Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 4023. Aquatic Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 and ES 3042, or equivalents. A survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as BIO 4303. Credit cannot be earned for both ES 4023 and BIO 4303.) Generally offered: Fall of even years. This course has Differential Tuition. Course Fee: STFE \$40.

**ES 4033. Plant Physiological Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 and ES 3042, or equivalents. A survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as BIO 4313. Credit cannot be earned for both ES 4033 and BIO 4313.) Generally offered: Fall of even years. This course has Differential Tuition.

**ES 4073. Social Science Research Methods. (3-0) 3 Credit Hours.**

Prerequisite: A minimum of 60 semester credit hours, or consent of instructor. The objective of this course is to introduce social science research methods which are (a) commonly used in biological research (e.g., human dimensions research, public lands management, medical research) and (b) essential for research directly engaging stakeholders and the public (e.g., citizen science or community-based research). The course engages ethical and legal obligations related to human-subjects research. It introduces 5 different data collection methods: surveys, interviews, focus groups, ethnographic and community-based research methods, as well as audiovisual/textual artifact analysis (e.g., photographs, etc.). Assignments emphasize writing skills specific to these methods and provide opportunities to actively engage different data collection methods (e.g., via field observations). This course has Differential Tuition.

**ES 4103. Global Change. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 or equivalent. This course will cover the large-scale physical mechanisms by which the climate is regulated through time as well as the probable future changes to global systems. The potential impacts on the abiotic and biotic systems will be discussed and considered. Past, current, and future efforts of local, national, and international entities to mitigate and adapt to future climate change scenarios will also be evaluated and assessed. (Formerly ES 4104. Credit cannot be earned for both ES 4103 and ES 4104.) Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 4111. Field Biology Laboratory. (0-3) 1 Credit Hour.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4113 and ES 4123 is recommended. A field-oriented course offering the opportunity for practical experience observing, collecting, and identifying Texas plants and animals. (Same as BIO 4241. Credit cannot be earned for both ES 4111 and BIO 4241.) Generally offered in Summer. This course has Differential Tuition. Course Fee: IUS1 \$15.

**ES 4113. Field Biology. (3-0) 3 Credit Hours.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4111 and ES 4123 is recommended. A multi-week, off-campus, field-oriented course offering the opportunity for practical experience observing, collecting, and identifying plants and animals of the American Southwest. (Same as BIO 4233. Credit cannot be earned for both ES 4113 and BIO 4233.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

**ES 4123. Desert Biology. (2-3) 3 Credit Hours.**

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4113 and ES 4111 is recommended. A multi-week, off-campus, field-oriented course focused on the study of the deserts of the world, emphasizing the deserts of the American Southwest. Adaptations of plants and animals and their responses to desert conditions, as well as examinations of desert climatic patterns, geology, and natural history. (Same as BIO 4043. Credit cannot be earned for both ES 4123 and BIO 4043.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15.



**ES 4133. Natural Resource Policy and Administration. (3-0) 3 Credit Hours.**

A course designed to introduce students to the evolution of forest, range, wildlife, and related natural resources policies and administration in the United States. The National Environmental Policy Act (NEPA) and Endangered Species Act will be examined in detail. This course will expand upon ES 3203 (Environmental Law) and provide a historical perspective of natural resource conservation and the federal and state agencies that manage and oversee natural resources in the United States. The last part of this course will focus on non-governmental agencies, stakeholders, public relations, budgeting, and planning. This course is required for some tracks in the Integrative Biology program. Credit cannot be earned for both BIO 4233 and ES 4133. This course has Differential Tuition.

**ES 4153. Introduction to Sustainability. (3-0) 3 Credit Hours.**

Prerequisites: ES 2023 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. This course will examine the major environmental issues and trends happening in modern society from a scientific and practical perspective, including biodiversity, population, food and water resources, climate change, energy, public health, and the overall forecast for the environment for the next several decades. This course has Differential Tuition. Course fee: DL01 \$75.

**ES 4163. Renewable Energy. (3-0) 3 Credit Hours.**

Prerequisite: ES 2023 and a minimum of 60 semester credit hours, or consent of instructor. This course is an introduction to sustainable energy systems and resources. This class examines the practical and economic potential of the current sustainable energy sources as well as investigates newer technologies on the energy horizon. By the end of this class, students should have an understanding of the fundamentals of thermal solar, photovoltaic, biomass, hydro, wind, wave, tidal, and geothermal energy sources, including their environmental impacts, economics, and future prospects. Generally offered: Fall of even years. This course has Differential Tuition.

**ES 4173. Waste Water Treatment. (3-0) 3 Credit Hours.**

A course designed to introduce students to the fundamentals of water pollution and wastewater treatment. Students will be introduced to sources of pollution and control measures with a focus on streams, rivers, lakes, and reservoirs. Soil and atmospheric interactions that can affect water resources will also be emphasized. A major focus of the course will be on ground and surface water pollution. Toxicology, risk assessment, remediation, and sampling methods will be discussed. The wastewater treatment process will be introduced. This course has Differential Tuition. Course Fee: IUS1 \$15.

**ES 4183. Environmental Toxicology. (3-0) 3 Credit Hours.**

Prerequisite: CHE 1083, ES 2013, and ES 2023 or equivalents. Examination of advanced or specialized hazardous or toxic waste treatment methods. Emphasis will be on physical, chemical, and biological processes in treatment and processing of hazardous waste materials. Generally offered: Spring. This course has Differential Tuition.

**ES 4193. Planning and Response to Environmental Disasters. (3-0) 3 Credit Hours.**

Prerequisite: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. Mitigation of preparation for, response to, and recovery from environmental disasters. Generally offered: Fall of even years. This course has Differential Tuition.

**ES 4203. Environmental Assessment. (3-0) 3 Credit Hours.**

Prerequisites: ES 2013 and ES 2023, or equivalents. This course evaluates the framework of an impact assessment and details regarding the environment (air, water, soil), its pollutants (atmospheric, noise, water, solid waste), their impacts (physical, social, economic), relevant regulations, and pollution minimization or management strategies. Students use this information to review and comment on an existing Environmental Impact Statement (EIS). Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 4212. Professional Development for Environmental Science Careers. (2-0) 2 Credit Hours.**

Prerequisite: A minimum of 60 semester credit hours. This course is a broad-based professionalization course in which students have the opportunity to participate in their own professional development; identify and define their skills and competencies; create a comprehensive resume and/or CV; navigate employment websites and social media; create, present and defend a professional portfolio virtually and in person, and participate in public speaking. (Formerly ES 4211. Credit cannot be earned for both ES 4212 and ES 4211. Formerly titled "Senior Seminar".) This course has Differential Tuition.

**ES 4213. Conservation Biology. (3-0) 3 Credit Hours.**

Prerequisite: BIO 3283 or ES 3033 or equivalents. Class topics will include identifying and/or explaining biological and ecological principles central to conservation biology; critically evaluating reasons for conserving ecosystems and ecosystem services; explaining how the human dimension (human behavior, economics, land use, and others) affects the conservation of species; evaluating strategies and tools used to conserve species or habitat at risk of extinction or destruction; demonstrating skills in science communication: articulate and communicate a breadth of knowledge of conservation biology, conservation challenges, policies, and programs. (Same as BIO 4033. Credit cannot be earned for both ES 4213 and BIO 4033.) Generally offered: Spring. This course has Differential Tuition.

**ES 4223. Urban Wildlife Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 and ES 3042. This course will introduce students to the ecology of wildlife in urban areas. The first section of the course will focus on the fundamental components of urban ecosystems that define urban wildlife ecology and explore urban wildlife ecology in a Coupled Human and Natural Systems (CHANS) framework. The second section of this course will introduce students to the population and community-level responses of wildlife to urbanization. Lastly, the course will discuss the management of wildlife in urban areas. This course has Differential Tuition.

**ES 4233. Restoration Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 or BIO 3283, or equivalents. Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. (Same as BIO 4323. Credit cannot be earned for both ES 4233 and BIO 4323.) Generally offered: Spring. This course has Differential Tuition.

**ES 4243. Wildlife Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033. Major environmental factors affecting wildlife; structure, and behavior of wildlife populations; regional wildlife communities and their conservation. (Same as BIO 4053. Credit cannot be earned for both ES 4243 and BIO 4053.) Generally offered: Spring even years. This course has Differential Tuition.



**ES 4253. Sources, Fate, and Transport of Chemicals in the Environment. (3-0) 3 Credit Hours.**

Prerequisites: ES 2013, ES 2023, and MAT 1093, or equivalents. Sources of chemicals in the environment. Processes regulating fate and transport of metals, organics, nutrients, salts, pathogens, and radionuclides in the environment. Generally offered: Fall and Spring. This course has Differential Tuition.

**ES 4263. River Ecosystems. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 with a grade of at least a 'C-'. This course examines the physical, chemical, and biological factors that determine biodiversity and the structure and function of aquatic and riparian ecosystems. Key ecological and hydrogeomorphology concepts and their application to environmental concerns are covered. (Same as BIO 4263. Credit cannot be earned for both BIO 4263 and ES 4263.) Generally offered: Spring of even years. This course has Differential Tuition.

**ES 4273. Fish Ecology. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 with a grade of at least a 'C-'. A study of the biotic and abiotic factors affecting the diversity and distribution of fishes, with a focus on North American freshwater fishes. This course will include (1) lectures and discussions covering patterns and processes in fish ecology; and (2) a collaborative research project covering computational techniques used in fish ecology. (Same as BIO 4273. Credit cannot be earned for both BIO 4273 and ES 4273.) Generally offered: Fall of even years. This course has Differential Tuition.

**ES 4283. Plant-Soil-Microbe Interactions. (3-0) 3 Credit Hours.**

Prerequisite: ES 3033 with a grade of at least a 'C-'. Restricted to students who have completed 60 or more hours. This course focuses on the microbial groups which live in soils and among plant species and methodologies used to understand their interaction. (Same as BIO 4283. Credit cannot be earned for both BIO 4283 and ES 4283.) Generally offered: Spring of odd years. This course has Differential Tuition.

**ES 4293. Human Dimensions of Wildlife Management. (3-0) 3 Credit Hours.**

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. This course will introduce students to the role that humans play in the management of wildlife and how people's knowledge, values, and behaviors influence conservation decisions. Students taking this course will develop an understanding of the social, political, and economical drivers of wildlife management and explore ways to engage stakeholders in wildlife management through conservation tools and effective communication that considers human dimensions. An emphasis will be placed on working with private landowners to train students to work in private landscapes where culture, society, politics, and economics often provide the context for management decisions. #This is highly relevant in Texas, where private lands comprise around 95% of the state. Generally offered: Spring in even years. This course has Differential Tuition.

**ES 4303. Principles of Wildlife Management. (3-0) 3 Credit Hours.**

Prerequisite: ES 4243. Ways of conserving desired numbers of animals for the overall best interests of society, be they aesthetic, ecological, economic, commercial, or recreational; includes management of endangered species, exploited species, wildlife communities in nature reserves, and wildlife pests. Generally offered: Spring even years. This course has Differential Tuition.

**ES 4503. Introduction to Environmental Risk Assessment. (3-0) 3 Credit Hours.**

Prerequisite: ES 4183 with a grade of "C-" or better. This course will offer hands-on training in the primary areas of risk assessment (i.e., hazard identification, dose-response assessment, exposure assessment, and risk characterization). Generally offered: Fall of odd years. This course has Differential Tuition.

**ES 4513. Advanced Environmental Risk Assessment. (3-0) 3 Credit Hours.**

Prerequisite: ES 4503 with a grade of at least a 'C-'. This course will offer hands-on training in the advanced areas of risk assessment (i.e., hazard identification, dose-response assessment, exposure assessment, and risk characterization). Generally offered: Spring of even years. This course has Differential Tuition.

**ES 4911. Independent Study. (0-0) 1 Credit Hour.**

Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**ES 4912. Independent Study. (0-0) 2 Credit Hours.**

Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**ES 4913. Independent Study. (0-0) 3 Credit Hours.**

Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, and Summer. This course has Differential Tuition.

**ES 4953. Special Studies in Environmental Science. (3-0) 3 Credit Hours.**

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: variable. This course has Differential Tuition. Course Fee: DL01 \$75.

**ES 4963. Internship. (0-0) 3 Credit Hours.**

Prerequisite: Consent of the Undergraduate Advisor of Record. An opportunity for students to work in a setting that permits them to apply what they have learned in the formal instruction part of the program. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

**ES 4991. Directed Research. (0-0) 1 Credit Hour.**

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. The directed research course may involve either a laboratory or a theoretical problem. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit, but no more than 6 hours, regardless of discipline, in combination with ES 4911-3 (Independent Study), will apply to the Bachelor's degree. This course has Differential Tuition.

**ES 4992. Directed Research. (0-0) 2 Credit Hours.**

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. The directed research course may involve either a laboratory or a theoretical problem. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with ES 4911-3 (Independent Study), which will apply to the Bachelor's degree. This course has Differential Tuition.

**ES 4993. Directed Research. (0-0) 3 Credit Hours.**

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. The directed research course may involve either a laboratory or a theoretical problem. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with ES 4913-3 (Independent Study), will apply to the Bachelor's degree. This course has Differential Tuition.